EDITORIAL

FOR a long time, the news has been dominated, as far as scientific achievement is concerned, by space probes and ballistic missiles.

Before that there were hydrogen and atom bombs and the achievements of aircraft manufacturers, then entering upon the jet age.

All these things by nature, are spectacular, appealing to the imagination and fulfilling, in fact, the picturesque prophecies of science fiction writers.

In the meantime, however, tremendous progress has been made in a completely different field, which is no less important to us as individuals. I refer to medical electronics.

Some of its aspects are long established and well known as, for example, diagnosis and treatment of disease by radiology. Many other interesting lines of investigation have been opened up, but have often been hindered by the necessity for medical men, knowing little of electronics, to interpret their requirements to "radio" experts who were equally ignorant of medicine.

Recently, medical electronics has begun to emerge as a separate and distinct field of research with a much smaller gap between those whose training has been predominantly either "medical" or "electronic." Symposiums and specialist groups are becoming commonplace and this present issue carries a report of the second International Conference on Medical Electronics held recently in Paris.

The report tells of a lecturer, quite unconcernedly swallowing a complete, working radio transmitter, so that he could track its course through his body as the lecture progressed.

Unusual as this may be, there is something bordering on the fantastic in the further reference to a patient depending for his life on a multivibrator, an accumulator and a battery charger, completely sealed into the stomach below the breastbone.

Another new technique, not mentioned in this article, involves giving a patient massive dosages of cobalt radiation to reduce his chemical defences against foreign bodies, then, while in such a state, transplanting into his body a complete new organ.

As we gaze at the stars, let us not overlook the men who are currently making history in the world's operating theatres.

Williams

INDEX

Page
Manned Space Vehicles 3
Minerals From Sea Floor 4
£88-million Telephone Account 7
Ceramic Is Tough 11
New Industries In 2 States 13
BBC To Expand Educational TV 15
Machine Winds 84-Wire Cable 15
Study Of Waves A Science 16
Technical Review 21
News and Views of The Month 29
10-Watt Class-B Modulator 32
The Serviceman Who Tells 41
Transistor Amplifier—Part 2 48
AC Supply For Transistor Amp. 51

Page
A Reader Built It 59
Here's Your Answer, Tom 61
Typical Complete Playmaster 64
Panel For Pattern Generator 69
Maser, Parametric Amplifiers 73
Protect Meters From Overload 80
Australian Broadcast Stations 86
Let's Buy An Argument 88
Trade Reviews And Releases 97
Off The Record 101
Amateur Bands With Bill Moore 112
Short-Wave Notes 115
Answers To Correspondents 121
R., TV & H. Crossword 127

RADIO ★★ TELEVISION AND HOBBIES

A NATIONAL MAGAZINE OF RADIO, TELEVISION HOBBIES AND POPULAR SCIENCE

EDITOR
JOHN MOYLE
S.M.I.R.E. (Aust.)

TECHNICAL EDITOR
NEVILLE WILLIAMS
M.I.R.E. (Aust.)

TECHNICAL STAFF
PHILIP WATSON
A.M.I.R.E. (Aust.)

JOHN BARKER

WES YASHIN

MERVYN HUDDLESTON

Vol. 21 No. 9

SUBSCRIPTION RATES
C'wealth, N.Z., N. Guinea, Fiji — £1/10/- p.a.
United Kingdom — £1/13/- p.a.
British Empire — £1/15/- p.a.
Foreign — £1/17/- p.a.

Editorial Offices . . . Jones St., Broadway, Sydney.

Postal Address . . . Box 2728 G.P.O., Sydney.

Phone B0944

OUR COVER PICTURE

Designed specially for week-end sportsmen, this new cab has been designed by General Motors, America, and is being offered through their network of truck dealers. It fits their "wideside" pickup vehicles and can be installed or removed in a few minutes. (See also panel, page 4.)

SAVE POUNDS

on Goldring diamonds

To meet increasing world-wide demand, Goldring have now perfected new mass-production techniques making it possible to offer diamonds for all crystal cartridges *at greatly reduced prices.*

Because Goldring Diamonds offer long-term, high-grade service, it's not economical to buy Diamonds for cartridges which are outdated (manufacture discontinued 5 or more years ago), as there is every possibility the Goldring "long-life" Diamond would outlast such cartridge. On the other hand it is now *most* economical to buy a new cartridge fitted with L.P. or Stereo Diamonds.

Up-to-date cartridges, as currently used by the world's famous manufacturers, can now be supplied, complete with a Goldring Diamond at a price no greater than you'd once have paid for the Diamond alone.

Don't take a chance on your present Stylus. Long before you can hear a falling-off in reproduction, constant unseen wear can do irreparable damage to valuable records. Check the price lists below and you'll be amazed at just how economical it is to replace your present cartridge with a new diamond fitted.

ONLY GOLDRING CAN OFFER THIS COMPREHENSIVE RANGE TO THE PUBLIC

DIAMONDS

MONOPHONIC *(For L.P. Records only)*

		£
D/16	Acos HGP.37-IC	4. 0. 0.
D/17	Ronette TO. 284	4. 0. 0.
D/18	Garrard—GC.2	4. 0. 0.
D/20	Goldring 500 and 555	7. 0. 0.
D/32	Dual D.N.2	5.10. 0.
D/35	B.S.R. TC.8M	4. 0. 0.
D/40	Goldring 600	7. 0. 0.
D/42	Ronette TX.88	5.10. 0.
D/43	Ronette DC.284.OV	4. 0. 0.

STEREO *(For Stereo and L.P. Records)*

D/35/S	B.S.R. TC.8/S	4. 0. 0.
D/44	Ronette Stereo	4. 0. 0.
D/47	Garrard GC.10	4. 0. 0.
D/48	Acos GP.73	5.10. 0.
D/50	Goldring 700 (Stereo only)	7. 0. 0.

CARTRIDGES WITH DIAMOND

MONOPHONIC *(For Standard and L.P. Records)*

		£
B.S.R. TC. 8M	With L.P. Diamond D/35	6. 18. 6
Acos HGP.37-IC	With L.P. Diamond D/16	6. 18. 6
Ronette DC.284 OV.	With L.P. Diamond D/43	6. 17. 6
Ronette TX.88	With L.P. Diamond D/42	8. 9. 9
Garrard GC.8	With L.P. Diamond D/39	6. 17.11
Goldring 600	With L.P. Diamond D/40	10. 10. 0

STEREO *(For Standard, L.P. and Stereo Records)*

B.S.R. TC.8/S	With Stereo/L.P. Diamond D/35.8	9. 5. 0
Ronette Single-sided BF.40 (Stereo only)	With Stereo/L.P. Diamond D/44	8. 5. 6
Ronette Turnover Stereo OV.	With Stereo/L.P. Diamond D/44	8. 12. 6
Acos GP.73	With Stereo/L.P. Diamond D/48	11. 5. 0
Garrard GC.10	With Stereo/L.P. Diamond D/47	8. 6. 6
Goldring 700 (Stereo only)	With Stereo/L.P. Diamond D/50	18. 10. 0

RECORD CARE ACCESSORIES

The Goldring Record Care Accessories will help you to keep your records in perfect condition

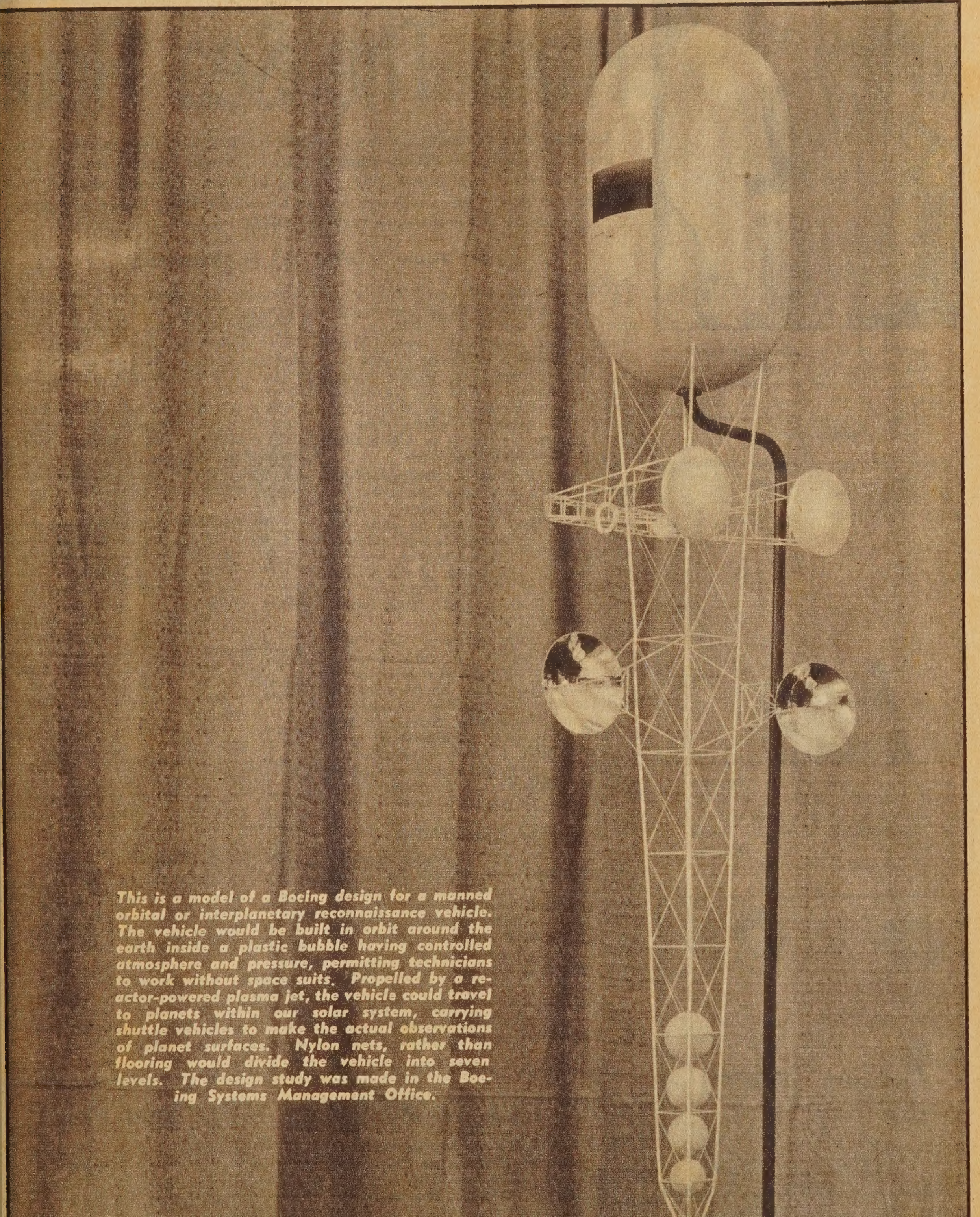
● Styli Inspector	1. 1. 0
● Pressure Gauge	19. 6
● Dust Brush (easily fitted to every Pickup arm).	2. 6

For the finest in all record playing equipment contact:

GOLDRING
ENGINEERING (AUST.) PTY. LTD.
449 Kent St., Sydney. Phone BX 1275/6

Merry Christmas to all our friends in the Industry

PLAN FOR MANNED SPACE VEHICLE

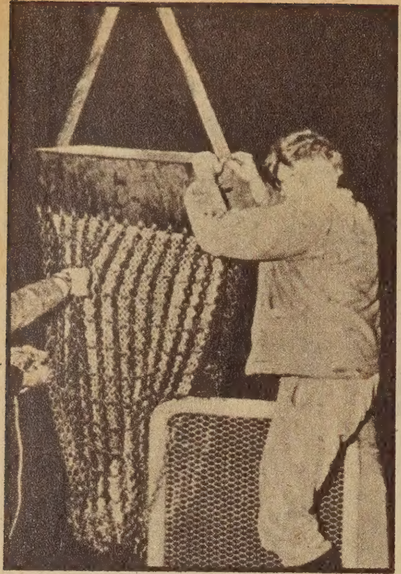


This is a model of a Boeing design for a manned orbital or interplanetary reconnaissance vehicle. The vehicle would be built in orbit around the earth inside a plastic bubble having controlled atmosphere and pressure, permitting technicians to work without space suits. Propelled by a reactor-powered plasma jet, the vehicle could travel to planets within our solar system, carrying shuttle vehicles to make the actual observations of planet surfaces. Nylon nets, rather than flooring would divide the vehicle into seven levels. The design study was made in the Boeing Systems Management Office.

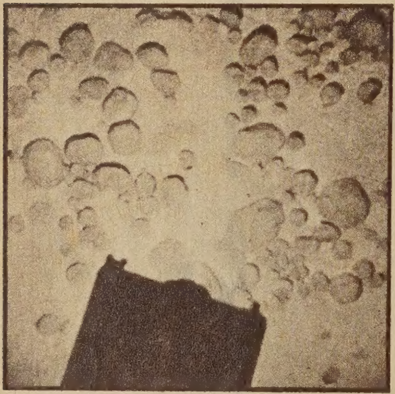
Valuable Minerals From The Sea Floor

Soon we may be sweeping the sea floor for strategic and valuable minerals. At least 14½ million square miles of ocean bottom, recent discoveries show, are strewn with nuggets of them. Typically shaped like potatoes, sized from a pigeon's egg to a football, these brown and black lumps of light porous rock are called manganese nodules.

By Roscoe and W. N. Fleming



To gather nodules, scientists lower a rock dredge from research vessel Horizon. Proposed drag dredge for mining nodules would be large-scale version of this scientific implement.



Manganese nodules on Atlantic floor, 18,000 feet down, are view-by camera. Its shadow is at bottom of this striking photo by David Owens of Woods Hole Oceanographic Institute.

Biggest manganese nodule brought up so far is 125-pounder, 25 inches long, being measured here. It was recovered in 1951 by ship Horizon, of Scripps Institution of Oceanography, north of Hawaii.

HOW valuable is the ore? The lumps of rock average 20 per cent manganese, 15 per cent iron, half a per cent apiece cobalt, nickel and copper. Many are even richer. The nodules within a single square mile hold 500,000 dollars' worth of metals. And it's feasible to "mine" the sea for them, with techniques now available, reports John L. Mero, of the University of California's Institute of Marine Resources.

Discovery of minable quantities of the nodules was a surprise of the recent International Geophysical Year. Specimens have been dredged up since the 1870s, but their abundance was unknown until a 1957-58 cruise by the research ships Horizon and Baird, of the Scripps Institution of Oceanography at La Jolla, Cal., found a great South Pacific area covered with them.

As other ships extended the finds, Mero was assigned to study whether they could be commercially exploited.

The nodules resemble no other known manganese or iron mineral. Cross-sectioned, they show thin concentric layers like an onion's, often built up with a shark's tooth, a whale's earbone, or a lump of clay as a nucleus—at an estimated growth rate of about 1/100 of an inch every 2,500 years.

MANGANESE CONTENT

Their content of manganese, which is oxidised, mysteriously exceeds that of sea water by 10 million times. Possibly living organisms concentrated it. By another theory, objects protruding above the sea floor were made battery-like electrodes, by sea-bottom currents in the earth's magnetic field, and metals plated upon them.

Laboratory tests by Mero show the nodules make excellent ore. Dried, they can be crushed even in the hand. They're amenable to present ways of extracting manganese and would yield a ton, worth 43 dollars, at a total cost of 25 dollars to 35 dollars for mining, transportation and processing. Their prized cobalt and nickel, also recoverable, promise added return.

How can they be harvested? Simplest of several ways proposed by Mero is by drag dredging. Towed slowly along the ocean floor, an open boxlike scoop would fill with nodules. Then it would be raised, emptied and returned for another haul.

This would be practical at the moderate depth of a reported field of nodules in the Atlantic off Florida, only 500 to 3,000ft deep; and at another field of 3,800ft depth at Tuamotu Ridge in the South Pacific.

Deeper nodules call for hydraulic dredging. Vast Pacific beds three miles down inspire Mero's most radical plan:

A huge barge would lower a pipelike oil-well casing but at least 15in in diameter. Motors attached at intervals, and controlled by gyroscopes, keep it vertical. At its lower end, extension pipes with suction heads snuff up nodules, to be pumped up the pipe to the barge. The crew would turn on the suction, and the rig would then move slowly about, like a housewife vacuum-cleaning a rug.

ON HUGE SCALE

Such an operation must be on a grand scale. Lower limit would be a 10-million dollar outfit, able to recover 500 tons of nodules daily. A 5,000-ton-a-day dredging rig might cost 60 million dollars.

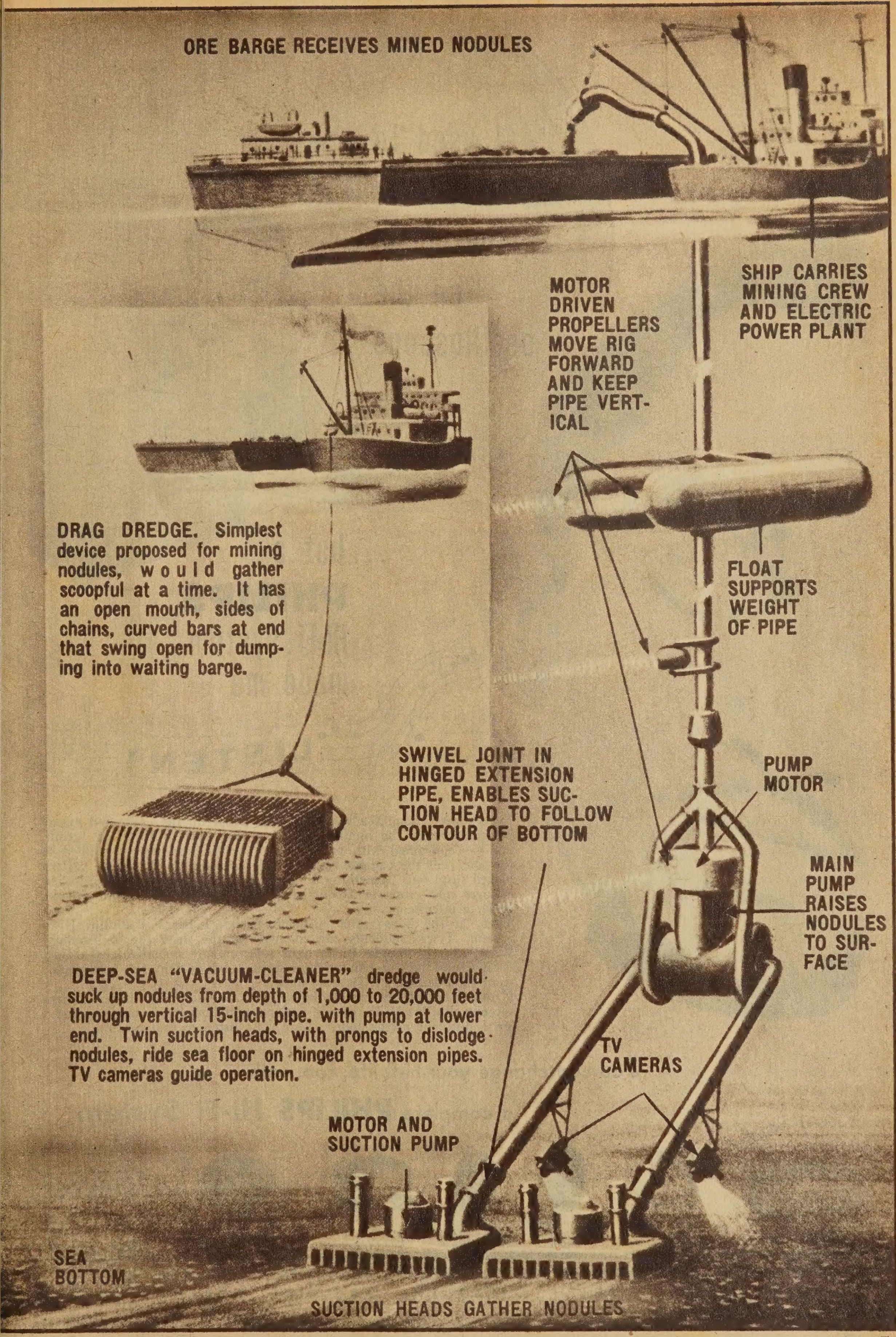
Mining the more easily accessible nodules may be under way sooner. Where they lie within 4,000ft of the surface, Mero declares, "a commercial venture may now be possible."

FOR WEEKEND SPORTSMEN — Our Cover Picture

FOR sportsmen or holiday makers, the G.M.C. wideside pickup with sports cab offers roomy, overnight accommodation for up to five persons. The interior measures 53in high, 74in wide and 98in long, has hardwood panelling, wide storage shelf and two six-footer bunks with thick cotton mattresses.

The exterior is all aluminium, finished in automotive enamel. The body is fully insulated with ¼in fibreglass. Roof ventilator and windows provide excellent ventilation. Two interior lights give illumination.

The sports cab fastens to the wideside box with six bolts and can be installed in only a few minutes.


ORE BARGE RECEIVES MINED NODULES
SHIP CARRIES MINING CREW AND ELECTRIC POWER PLANT
MOTOR DRIVEN PROPELLERS MOVE RIG FORWARD AND KEEP PIPE VERTICAL
FLOAT SUPPORTS WEIGHT OF PIPE
SWIVEL JOINT IN HINGED EXTENSION PIPE, ENABLES SUCTION HEAD TO FOLLOW CONTOUR OF BOTTOM
PUMP MOTOR
MAIN PUMP RAISES NODULES TO SURFACE
TV CAMERAS
MOTOR AND SUCTION PUMP
SEA BOTTOM
SUCTION HEADS GATHER NODULES

DRAG DREDGE. Simplest device proposed for mining nodules, would gather scoopful at a time. It has an open mouth, sides of chains, curved bars at end that swing open for dumping into waiting barge.

DEEP-SEA "VACUUM-CLEANER" dredge would suck up nodules from depth of 1,000 to 20,000 feet through vertical 15-inch pipe. with pump at lower end. Twin suction heads, with prongs to dislodge nodules, ride sea floor on hinged extension pipes. TV cameras guide operation.

I used to WATCH the music on the oscilloscope...
...but a PHILIPS Hi-Fi system made me LISTEN!

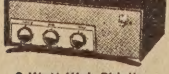
Every time I bought a record, I used to set up the calibrated microphone, connect the oscilloscope, start the music with bated breath, and — consumed with anxiety — I would keep my eyes glued to the screen of the cathode ray tube. If anything on the 'scope pattern looked suspicious (something always did), I would start checking tubes, voltages and crossover frequencies, and examine the record grooves under a microscope.

Then, at the house of a musician friend, I heard a Philips Hi-Fi System. I was suddenly carried away by the sheer joy of listening! What a lovely sound! Clean tight bass; creamy smooth highs; crisply defined middles . . . the strings went la-lah-de-dah; the kettledrums went dum-dedum . . . it was music!

I rushed out of my friend's house to the nearest hi-fi dealer, bought my own Philips Hi-Fi System, took it right home with me . . . and I am a different person today. Man, just listen to that music!

You can change your hi-fi life, too, with

a complete **PHILIPS Hi-Fi System**


8 Watt High-Fidelity Amplifier EV4430

Bass Reflex Enclosure 1053

8" Twin Cone Speaker 9710m

12" Twin Cone Speaker 9762m

Stereo Control Unit EV4407

4 Speed Record Player AG2005Y

PHILIPS

CONTACT YOUR AUDIO DEALER OR PHILIPS ELECTRICAL INDUSTRIES PTY. LIMITED
SYDNEY BRISBANE PERTH MELBOURNE ADELAIDE HOBART

P1728-59

Under the watchful eye of the officer on duty, a heavy submarine cable is paid out astern, to rest for years on the sea floor.

An 88-Million Pound Telephone Account

Before a British Commonwealth citizen makes his first round-the-world telephone call, he and millions of his fellows will have paid an £stg 88-million telephone bill, for the British Commonwealth's global telephone link-up.

By Keith Bean

IN these take-it-for-granted days news of the link-up has received little prominence but it is, in fact, a tremendous scientific achievement.

The undertaking is a tribute to the great pioneering work done in earlier years in Britain. It reveals the enormous strides taken in this field since the war and the even more exciting possibilities of work now in hand. Even the first stage of the round-the-world cable —the Britain-Canada link on which work is now in progress—will mark up distinct advances on any existing ocean telephone system.

AMPLIFICATION

The secret of the working of the undersea telephone cables is simply—amplification. A telephone cable, like an ordinary electric power flex, has to carry an electric current, in this case an electric signal. If the cable is very long, stretching over hundreds or even thousands of miles, the electric signal is seriously reduced in strength.

Part of its strength is lost because of "resistance" in the copper strands of the inner cable; part by "seepage" through the insulation around the cable. Thus, by the time the original message has run "unaided" from one end of a long cable to the other, it has become very weak indeed.

Amplification has solved this problem. Distributed along the length of the cable are a number of repeater units which receive the message, before it becomes too weak, and boost its power back to its original strength. This is then transmitted to the next repeater or "booster" and so on until the cable reaches the receiving office.

The ocean-cable booster was developed in 1942 and first used in the Irish Sea. By 1946 it was possible to lay a 225-mile cable under the North Sea from Suffolk to the British Occupation Army in Germany.

Immediately the research men pressed on. For the dangerous deeper waters of the Atlantic, they designed a repeater valve which would have not only extremely high performance but also a very long life. A "non-fail" arrangement of the repeater circuit followed.

Then, because the Atlantic goes down more than 2½ miles on the cable route and pressure is around three tons per square inch at those depths, a strong new housing was developed for the repeaters.

All these improvements were built into the 350-mile Scotland-Norway telephone cable, then the world's longest, laid in 1954. By then there were 41 ocean-bed repeaters in telephone cables in European waters—and all the cables and repeaters had been made in the United Kingdom and laid by British ships.

TRANS-ATLANTIC LINK

It was therefore natural that a British combine, Submarine Cables Ltd., comprising more than one cable manufacturing firm, should be chosen to provide the cable for the first trans-Atlantic undersea phone link begun under an Anglo-American-Canadian agreement in 1954 and completed in 1956.

But one-way repeaters, developed in the United States, were chosen, which meant that two cables had to be laid, over 48,000 miles of cable in all. It was made to a rigid specification that demanded such purity of materials that the company had to provide X-ray inspection and new workshops with filtered air and chemical washing equipment which produced conditions of hospital cleanliness.

In spite of the precision work involved, the cable was delivered ahead of schedule and laid by H.M.T.S. Monarch, the only ship afloat capable of laying a cable in one operation across the deep section of the North Atlantic, all within two years.

Opened in September, 1956, it carried 430,000 calls in its first year. In little more than that, U.K.-U.S. calls had doubled and U.K.-Canada calls trebled.

FOLLOWS PATTERN

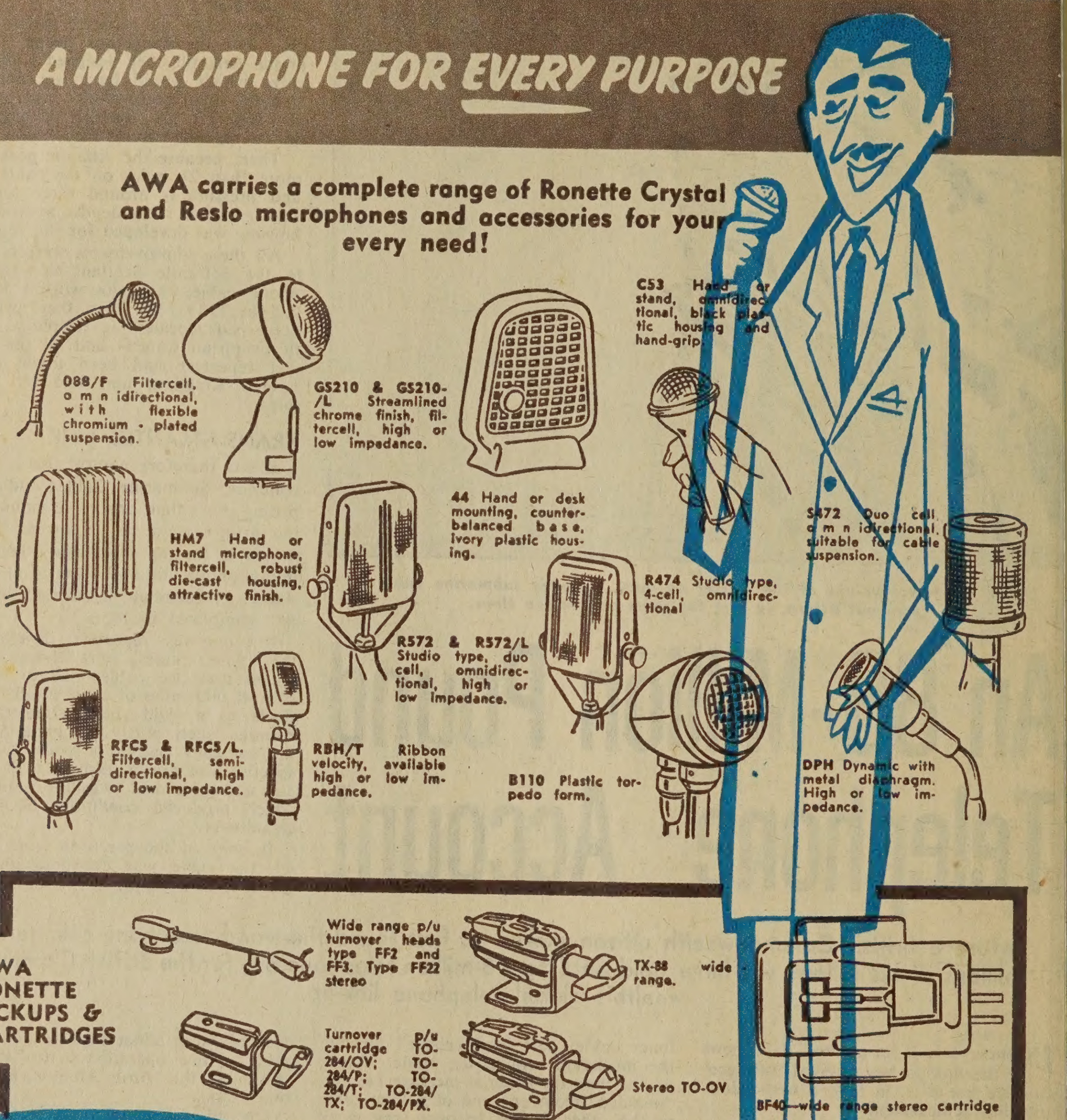
This fits in with telephone experience everywhere. When the phone system improves, demand leaps fantastically and keeps on rising. This is why the Commonwealth experts are confident that the new round-the-world cable will be a very definite paying proposition.

Thanks to further research, the number of circuits between Britain and Canada has since been doubled for peak working hours. This has been done with equipment which packs the speech channels more closely, so any cable can carry a third more calls without noticeable loss of speech clarity.

The new link with Canada, on which work is now in progress, as part of

A MICROPHONE FOR EVERY PURPOSE

AWA carries a complete range of Ronette Crystal and Reslo microphones and accessories for your every need!



088/F Filtercell, omnidirectional, with flexible chromium - plated suspension.

GS210 & GS210-/L Streamlined chrome finish, filtercell, high or low impedance.

C53 Hand or stand, omnidirectional, black plastic housing and hand-grip.

HM7 Hand or stand microphone, filtercell, robust die-cast housing, attractive finish.

44 Hand or desk mounting, counter-balanced base, ivory plastic housing.

S472 Duo cell, omnidirectional, suitable for cable suspension.

R474 Studio type, 4-cell, omnidirectional

R572 & R572/L Studio type, duo cell, omnidirectional, high or low impedance.

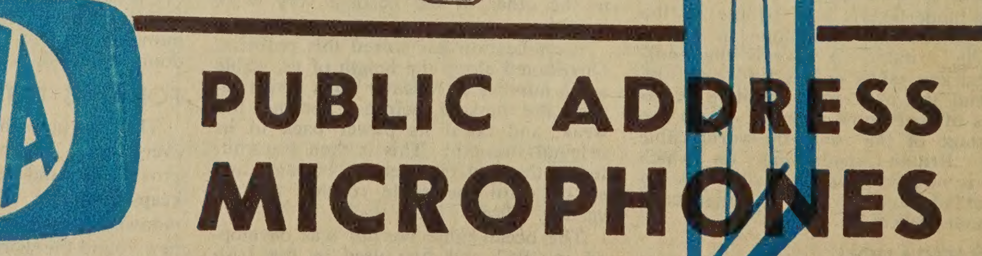
RFC5 & RFC5/L. Filtercell, semi-directional, high or low impedance.

RBH/T Ribbon velocity, available high or low impedance.

B110 Plastic torpedo form.

DPH Dynamic with metal diaphragm. High or low impedance.

AWA RONETTE PICKUPS & CARTRIDGES



Wide range p/u turnover heads type FF2 and FF3. Type FF22 stereo

TX-88 wide range.

Turnover p/u cartridge TO-284/OV; TO-284/P; TO-284/T; TO-284/TX; TO-284/PX.

Stereo TO-OV

BF40—wide range stereo cartridge

PUBLIC ADDRESS MICROPHONES

Marketed and guaranteed by

AMALGAMATED WIRELESS (AUSTRALASIA) LIMITED

● 554 PARRAMATTA ROAD, ASHFIELD. UA0791. ● 167 QUEEN STREET, MELBOURNE. MU9161.

Available in other states from:—
NEWTON McLAREN LTD., ADELAIDE ● NICHOLSON'S LTD., PERTH ● CHANDLERS PTY. LTD., BRISBANE. and from leading wholesalers.

ıe round-the-world system, will be ble to provide eighty telephone ciruits on only one cable. The use of single cable is made possible by the evelopment of a new British two-way epeater, 92 of which have been orderd from Standard Telephone and ables Ltd.

These repeaters are quite revolutionry. They are big and, unlike the 956 repeaters which were actually uilt into the flexible cable, they are igid—miniature versions of the very olid repeater stations on land.

These big cable repeaters can carry nessages from both England and America simultaneously, whereas the maller repeaters could only transmit ne message, travelling in one direction t a time.

New types of laying machines have lso been developed to handle these arger rigid repeaters as part of a coninuous cable-laying operation.

Another novelty in the Commonwealth submarine telephone network will be a new type of cable which will ut out the need for outer steel armour in deep water, where almost perfect quiet reigns, and so reduce weight, size and cost. Or, put another way, the cable can carry vastly more phone circuits without becoming so big that it is uneconomic.

But the backroom boys are not resting on their laurels.

TRANSISTOR UNITS

Big things, in particular, are expected from their work on the transistor, the midget device conjured up little more than ten years ago to challenge the thermionic valve.

Already British makers have produced a transistorised country telephone system which works by batteries and so permits multi-channel working in areas where there are no electricity mains.

Next year the first all-electronic telephone exchange comes into operation in North London and the experts forecast that the exchanges to follow it will be very much more compact than those of today, cheaper to build, to house and to maintain.

And, of course, the transistor's advantages open a bright future for transocean telephones. With further development we should, for example, have transistor amplifiers suitable for submarine cables.

For one thing, they should enormously cut down the power needed for valve amplifiers. In the 1956 Atlantic cable a total operating voltage of 4,000 is necessary. For another, their small size will mean their easier incorporation and easier cable-laying.

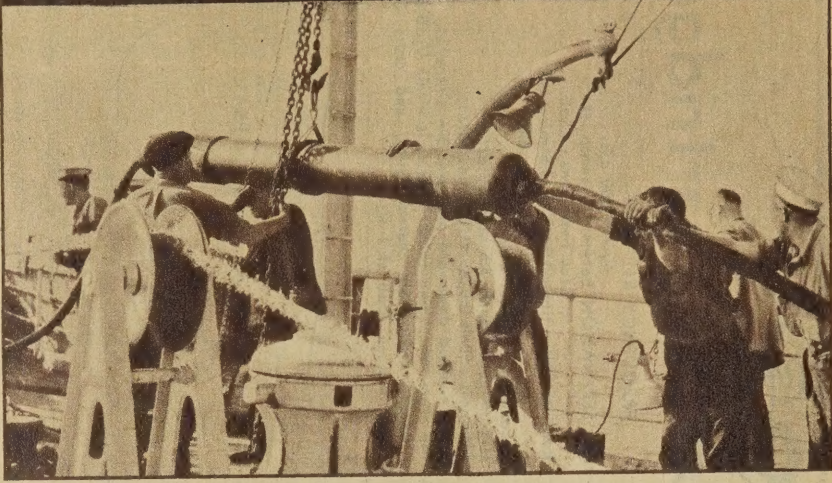
More important, transistor amplifiers in small repeaters connected into the cable at relatively short intervals can greatly widen the transmission band and that, by providing more speech channels per cable, can slash the price of calls.

But it has other possibilities. Already sound radio broadcasts can be transmitted by cable from America to Europe. Soon, perhaps, the cables will be able to cope with the much more complicated television "message" — which will mean that TV broadcasts will be transmitted from Britain to America (or vice versa) and give a clear picture on the home TV set.

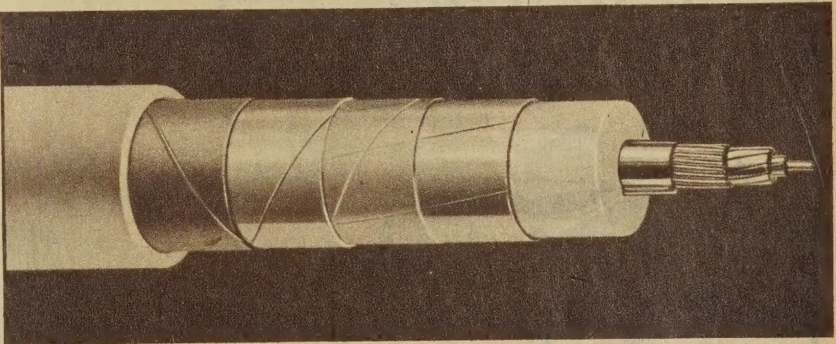
Recently Sir Gordon Radley, director-general of Britain's Post Office, said "Television cables between Europe and North America appear a technical possibility within the next ten years."

Ten years is the probable program time for completing the Commonwealth telephone cable, which could mean that its last links will be able to carry television. The citizens of Sydney or Hong Kong watching, live, the Lord's Test or the changing of the guard at Buckingham Palace? That's quite a thought.

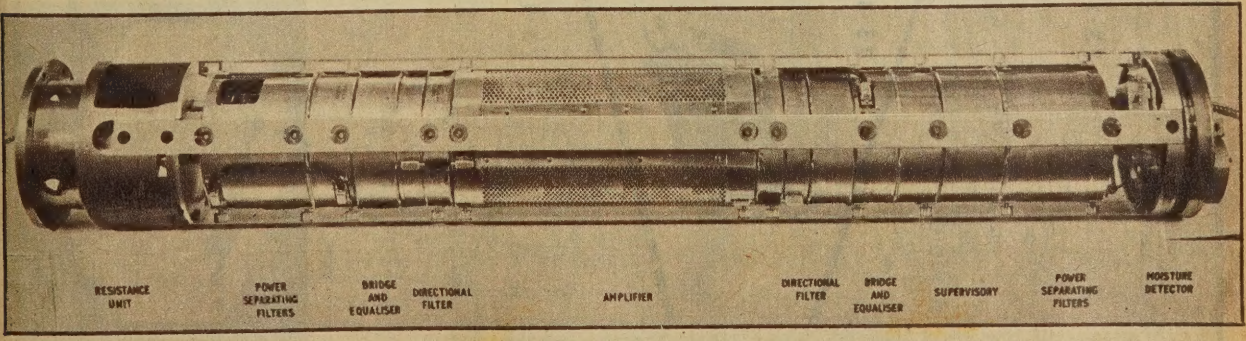
REPEATER GOES OVER THE STERN



Spliced into the cable, a repeater unit is drawn over the drums on the stern of the British Post Office cable-laying ship "Ariel."



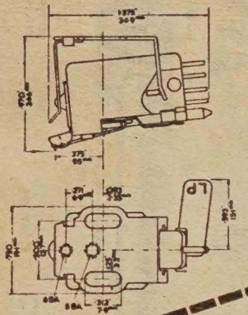
A cut-away specimen of the new lightweight (armourless) coaxial cable to be used for the U.K.-Canada link, scheduled for completion in 1961.



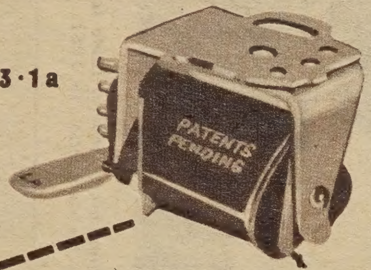
A typical cable repeater unit, capable of operating for years without attention.

ACOS

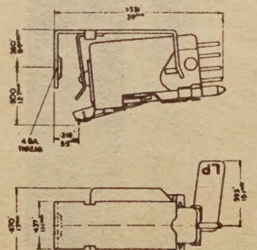
Crystal stereophonic cartridge

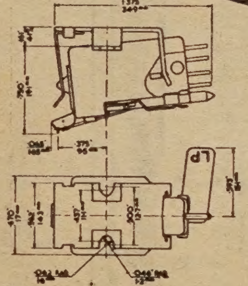


73·1a

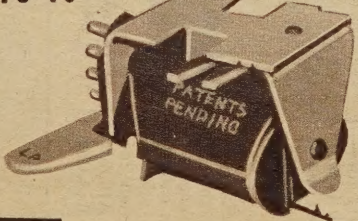


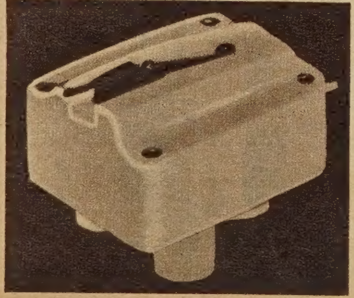
73·1b





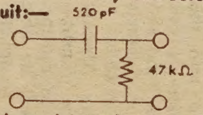
73·1c



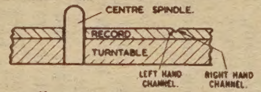


The "ACOStereo" 73-1 is a universal cartridge designed to play stereophonic and monophonic discs, including 78 r.p.m. coarse groove records. Three brackets are available. The "a" bracket fits the majority of arms, the "b" bracket fits Garrard RC. 110 and RC. 120 changers, and the "c" bracket is intended for American arms of the VM type.

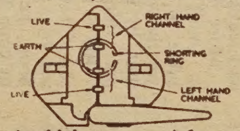
The output from the "ACOStereo" 73 is flat when fed into a 2Megohm impedance. If record compensation is available in the amplifier, it is advised that the output is converted to constant velocity characteristics by feeding through this circuit:—



The left-hand channel is defined as the channel reproduced by the left-hand speaker when viewed by the audience, and is recorded on the left-hand groove wall when the record is viewed as:—


CENTRE SPINDLE.
RECORD.
TURNTABLE.
LEFT HAND CHANNEL.
RIGHT HAND CHANNEL.

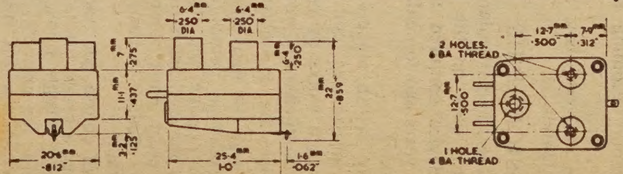
The "ACOStereo" cartridge connections as seen from the rear:—


LIVE
EARTH
LIVE
RIGHT HAND CHANNEL
SHORTING RING
LEFT HAND CHANNEL

The shorting ring should be removed for use with amplifiers requiring separate leads.

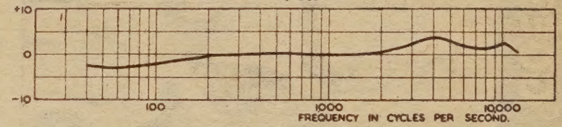
PERFORMANCE OUTPUT — 160 m.v. at 1 cm/sec.
Average — 300 mv.

71-3 For stereophonic and L. P. discs (non-turnover type).

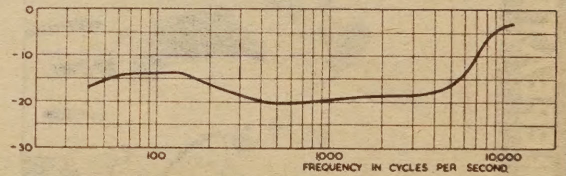

6·4 mm
·250" DIA
6·4 mm
·250" DIA
7 mm
·275"
11·1 mm
·437"
3·2 mm
·125"
20·6 mm
·812"
6·4 mm
·250"
22 mm
·859"
25·4 mm
1·0"
1·6 mm
·062"
2 HOLES. 6 BA THREAD
12·7 mm
·500"
7·9 mm
·312"
12·7 mm
·500"
1 HOLE. 4 BA THREAD

With Sapphire stylus—Price £4/9/6
With Diamond stylus—Price £10/17/6

FREQUENCY RESPONSE—
40—12,000 c/s.
SEPARATION between channels at
1 K/cs better than 20dB.
Radii of Stylus tips—0.0005" (13.5 microns).
0.0025" (62 microns).
Recommended load: 2 Megohm.
(Compliance equals 3.5 ucm/dyne).
(Stiffness equals 0.0286 x 10 dynes/MM).
Recommended downward pressure: 3-4 Grammes.
The Stereo recording characteristics is within ½dB of the RIAA/BS 1928/1955 characteristics, and cross talk is better than — 20db at 1 K/cs.



Frequency response on PS.131.



Separation between Channels on PS.131.

The response of both channels will be within 3dB.

All 73 series cartridges are available with two sapphire, sapphire and diamond or two diamond styli.
Prices: 73 series — Cartridge incl. 2 sapphire styli, £5/15/-, with sapphire and diamond styli £11/18/6, with 2 diamond styli £15/19/6.
Available ex stock.
"How Stereo Works" gladly posted on request.

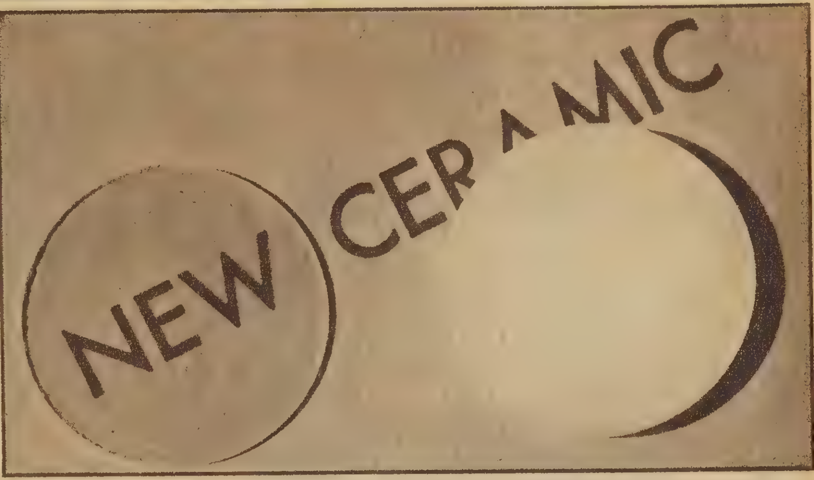
Australian Agents

AMPLION (A/SIA) PTY. LTD.

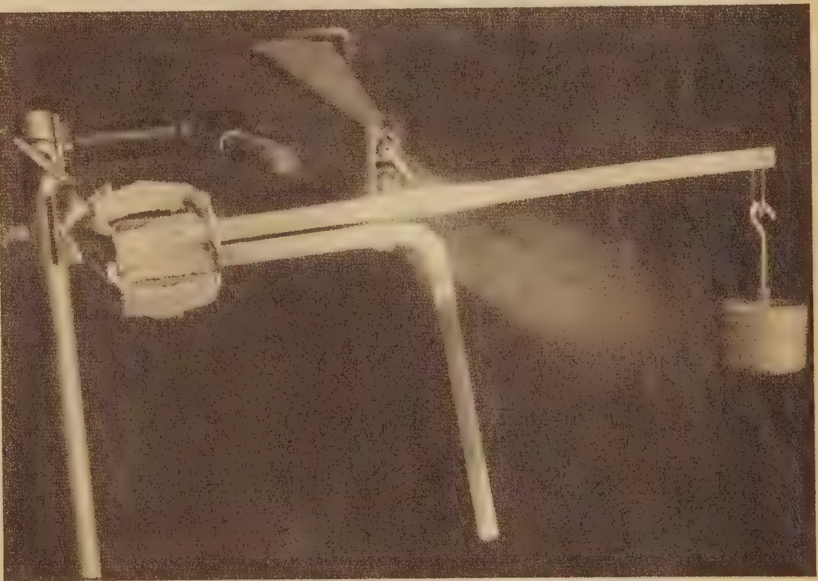
101 Pyrmont Bridge Road, Camperdown,
SYDNEY, N.S.W.

CERAMIC IS TOUGH, TRANSPARENT

A new ceramic material described as "history-making" in its unique combination of properties has been announced by Dr Guy Suits, vice president and director of research for the General Electric Company.



This picture illustrates the striking difference in transparency between the new ceramic and a conventional material.



A bar of Lucalox and a bar of fused quartz are heated by a blow torch. At a temperature of 2350deg. F, the bar of quartz bends under its own weight; the bar of Lucalox easily supports a 50 gram weight, even as the temperature climbs to 3200 deg. F.

"FOR the first time in history," said Suits, "a polycrystalline ceramic hat readily transmits light has been nade from powders. In addition to ransmitting light, the new material posesses the extremely high strength charcteristic of alumina ceramics, can withtand much higher temperatures than nost ceramics now in use, and can be ressed into any shape desired. No other naterial combines translucence with this legree of strength, heat resistance, and ase of fabrication."

"Lucalox," as General Electric calls he new material, is made from powlered aluminium oxide. It is closely reated to sapphire and ruby gem stones, vhich are single-crystal aluminium xide. But GE's polycrystalline form f the same compound is superior to hese gems in its ability to withstand nigh temperatures without deforming, ccording to Suits. Lucalox has the comosition of a ceramic, the structure of metal, and the light-transmitting ability pproaching that of glass.

BUBBLES REMOVED

The unique characteristics of Lucalox esult from the fact that the microscopically small pores, or "bubbles," that are normally found in ceramic materials nave been entirely removed, a feat that had been previously considered imposible.

Because of the elimination of the pores, it is possible to read through a sheet of Lucalox when it is laid flat upon a piece of paper. At greater distances it appears translucent, resembling frosted glass. At least 90 per cent of the light in the visible spectrum is transmitted through the new ceramic.

The basic material of Lucalox is fine-grain, high-purity aluminium oxide, or "alumina." The powder is pressed at room temperature, then fired at temperatures that are higher than usual for ceramics.

"This is one of the most significant advances in the field of ceramics in hundreds of years," declared Dr J. Herbert Hollomon, manager of the General Electric Research Laboratory's Metallurgy and Ceramics Research Department.

Lucalox resulted from an extensive investigation of the basic principles of the sintering process.

"The development of Lucalox," according to Hollomon, "should greatly enlarge the scientific, military and industrial uses of ceramics. As has been the case with many new materials, Lucalox should also extend the range of instruments and devices that are at present limited by the physical characteristics of available materials.

"One example would be high-intensity incandescent and discharge lamps, which are now limited by the heat-resistance of their transparent envelopes, in some cases. Fused quartz, which is often used for high-temperature lamps, performs satisfactorily up to 1800 degrees F.; Lucalox is stable at temperatures close to 3600 degrees F."

Another likely application for Lucalox is in the banks of infra-red lamps that are used to test the heat-resistance of missile nose-cones and other space-vehicle equipment. It may also be used as an electrical insulator and as a material for gem bearings in delicate equipment.

Present ceramic materials can be divided into three general categories:

Conventional ceramics, such as porcelains, in which the crystals are bonded together by low-melting glass—these approach, but do not reach, the 100 per cent density of the new material. They are limited by the low melting point of the bonding glass.

Oxide ceramics, more or less single phase—these are stronger than the porcelains, but, filled with light-scattering pores, they are opaque.

Single crystals, such as sapphire and ruby—these are transparent, but are limited in size and shape and are extremely difficult to fabricate.

Lucalox has a metal-like structure, in that its crystals are bonded directly to one another, with neither pores nor a glass matrix between them. Information gained from the study of this material may consequently be applied to powder metallurgy.

NEW Audio Amplifier Manual

Mullard
CIRCUITS FOR AUDIO AMPLIFIERS
POWER AMPLIFIERS AND PRE-AMPLIFIERS FOR MONAURAL AND STEREOPHONIC REPRODUCTION FROM MICROPHONE, RADIO, TAPE AND PICK-UP SIGNALS
12/6

15 COMPLETE CHAPTERS includin

- Amplifying Systems
- Sources of Distortion in Recorded Sound
- High-quality Amplification
- General Notes on Construction and Assembl
- Twenty-watt Amplifier
- Ten-watt Amplifier
- Three-watt Amplifier
- Two- and Three-valve Pre-amplifiers
- Input-mixing Pre-amplifiers
- Three-watt Tape Amplifier
- Tape Pre-amplifier
- Seven-watt Stereophonic Amplifier
- Three-valve Stereophonic Amplifier
- Stereophonic Pre-amplifier

Mullard

With the growing demand for high quality sound reproduction, more and more of the circuits in use today require specialised knowledge. This new publication fully describes the wide range of high-quality audio amplifier circuits designed by engineers of the Mullard Developmental Laboratories in the United Kingdom.

Four introductory chapters give a full technical explanation of monaural and stereophonic sound reproduction. The rest of the book comprises circuit descriptions, constructional details and performance figures of twelve Mullard circuits. These circuits include well-known Mullard designs, some modifications and improvements to these designs and a number of completely new designs.

MULLARD-AUSTRALIA PTY. LTD. Box 2118 G.P.O. SYDNEY

Please send me .... copies of "Circuits for Audio Amplifiers" for which I enclose .... remittance, being 12/6, plus 1/5 postage per copy.

NAME ....

ADDRESS ....

.... STATE ....

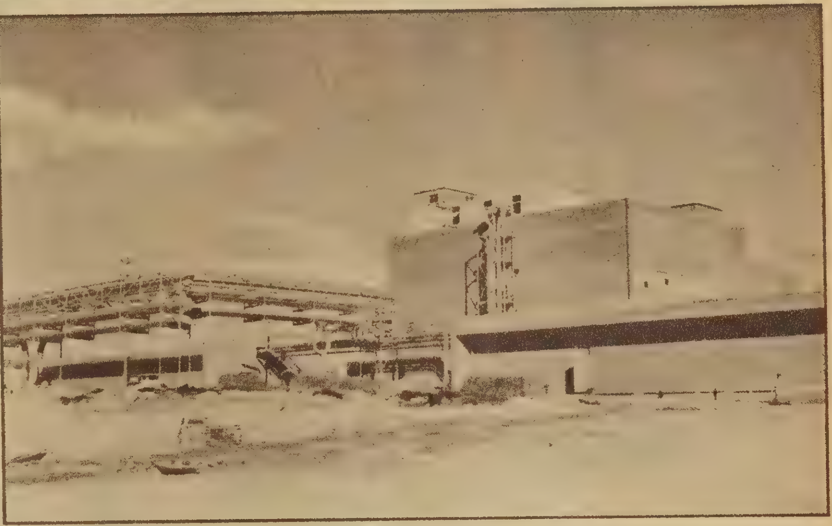
MULLARD-AUSTRALIA PTY. LTD., 35-43 CLARENCE ST., SYDNEY, BX2006 & 123-129 VICTORIA PDE., COLLINGWOOD, N.5. VIC. 41 6644
ASSOCIATED WITH MULLARD LIMITED, LONDON, MULLARD EQUIPMENT LIMITED AND MULLARD OVERSEAS LIMITED

MT91A

NEW INDUSTRIES IN TWO STATES

UGE PHOTOGRAPHIC LANT FOR KODAK

The most advanced equipment of its kind in the Southern Hemisphere will be located at East Coburg, Victoria, when the first stage of a 55-acre development project for Kodak (Australasia) Pty. Ltd. is completed there within the next few weeks.



HE company has already started the giant task of switching its entire eration to East Coburg. By 1965, dak will be supplying record quanti-s of sensitised goods, made to the ghest standards in the world.

Total employment when the whole 20-ilding development is completed will e above 2,000.

Kodak engineers, working with other stralian specialists, planned the equip-ent and lay-out of the new plant. Be-use the company's activity is unique Australasia, machinery and processes ve been ingeniously adapted.

The first stage, almost half of the planned development, consists of a power-house and separate divisions for sensitised emulsion mixing and coating, film testing and film finishing.

A feature of the power-house is its refrigeration plant, eventually to be three times larger than any other in Australia and equivalent to 100,000 household refrigerators.

Each compressor can produce 500 tons of ice in 24 hours. They will send 2,000 gallons of chilled water a minute through the air conditioning and film drying systems in the film manufacturing unit.

In addition, a brine cooling plant, using ethylene glycol, will supply below-freezing temperatures for cool storage and emulsion chillings.

Domestic water is another of the giant-size Kodak requirements and usage will be 20,000 gallons an hour, with a 100,000-gallon storage tank adjoining the power-house to act as reserve.

FLARE OF MATCH

In the emulsion mixing building, even the flare of a match could ruin emulsions worth thousands of pounds. The four-storey brick building has, therefore, been built windowless and equipped with many hundreds of coloured "safe lights" and automatic switches to keep working areas in near or complete darkness.

Equally stringent steps are taken to combat dirt. The air vents in the distilled water tanks are screened for antibiotic protection by ultra-violet rays, and air used in some of the drying processes is filtered several times.

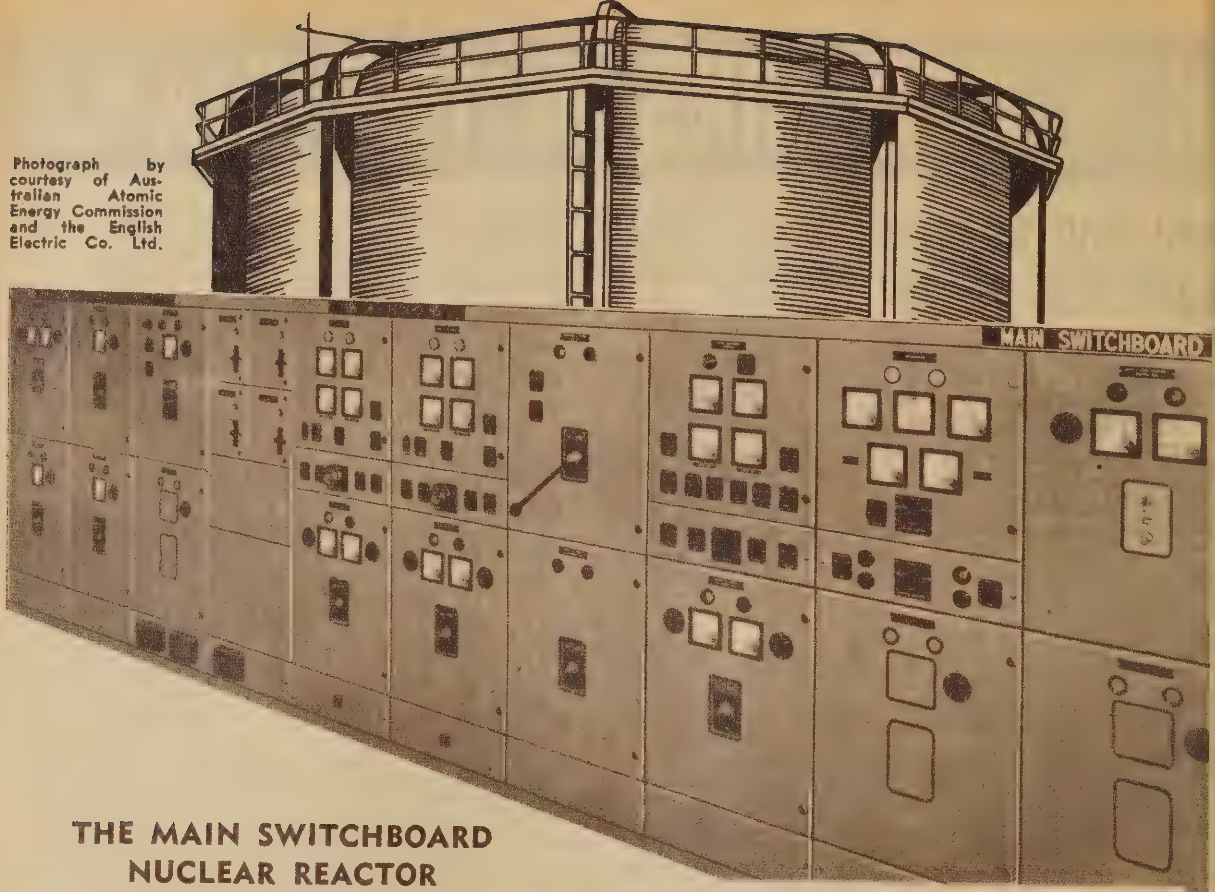
Kodak is the largest user of Australian produced silver, which is dissolved in nitric acid to provide the basic ingredient, silver nitrate, for the many types of sensitised emulsions.

These will be mixed in special "kettles" heat-controlled to very close accuracy and will be tested under all temperature conditions on precision machines.

The emulsions will be transferred to the coating division through an insulated and light-sealed passover between the buildings and then coated on to the film base, with extremely sensitive control of such vital factors as temperature, viscosity and quantity.

PHILIPS TRANSISTOR FACTORY

A full range of transistors, for use in radios and allied equipment, will be manufactured at a new £400,000 factory, recently opened by Philips Electrical Industries Pty. Ltd., at Hendon, South Australia. Production is already under way with seven different diode and transistor types. A full range of germanium and silicon products should be available early in the new year. Elaborate precautions have been taken in the new factory to obviate dust and to control temperature conditions in the working areas. Access can only be gained through dust control areas, where special uniforms can be put on and footwear cleaned. The picture above shows transistors being tested prior to packaging.

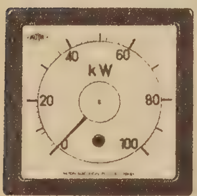


Photograph by courtesy of Australian Atomic Energy Commission and the English Electric Co. Ltd.

THE MAIN SWITCHBOARD NUCLEAR REACTOR

LUCAS HEIGHTS, N.S.W.

This switchboard is exclusively equipped with a representative range of PATON INSTRUMENTS, comprising: Ammeters, Voltmeters, Wattmeters, Power Factor, Frequency Meters, and Synchroscopes, etc.



536 CS

CONCENTRIC SCALE (250 degrees) METERS

Scale length up to 12 ins.

Available: 6½ and 5½ inches square—A.C.-D.C., Volt, Amp, Watt, Var, Power Factor, Synchroscopes, etc. Also in 4 inch Ammeters and Voltmeters only.

The MOST COMPREHENSIVE range of Electrical Measuring Instruments made in Australia.

SUPERB QUALITY, QUICK DELIVERY, LOW PRICES, Technical and Service Facilities.

Write for Catalogue

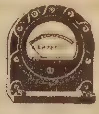
PATON ELECTRICAL PTY. LTD.

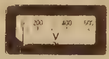
Ashfield, Sydney. **UA0381 (5 lines)**

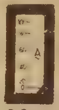
REPRESENTATIVES:—MELBOURNE: R. G. Holloway, 299 Little Lonsdale St. BRISBANE: K. H. Dore & Sons, 465 Adelaide St. ADELAIDE: E. Bown Ltd., 131 Wright Street. PERTH: Carlyle & Co. Ltd., 915-917 Hay Street. TASMANIA: Gebbie Harvey Pty. Ltd., 76 Wellington St., Launceston. NEW ZEALAND: Carrel & Carrel Ltd., 41 Shortland St., Auckland.

Controller

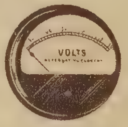
625


Flameproof


Hor. Edgewise


Ver. Edgewise

650

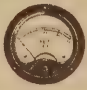

600

500

434Rd

475Rd

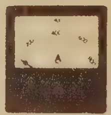
35Rd


32

216Rd

150

658Q


658

536

425

434Sq

400

35Sq

216Sq

HS1

SOLE AGENTS FOR—

ELMES-STAUB (Switzerland) Inkless Recording Instruments.
WATCHSTONES LTD. (Switzerland) Jewel Bearings.
MEGATRON (London) Photo Electric Cells.

.B.C. TO EXPAND DUCATIONAL TV

The B.B.C.'s experimental service of School Television Broadcasts, which began in September, 1957 has been so successful that it has now graduated from the stage of an experiment to that of a permanent nation-wide service which is to be greatly expanded.

NEWS of these developments was given recently in the report of the Senior ducation Officer of the School Broad- asting Council on the experiment since s inception, and with the announce- ent by the B.B.C. of its decisions as o the future of the service.

The School Broadcasting Council is he body representing the educational vorld in Britain which, for 30 years, has aid down the general policy of B.B.C. chools broadcasts and has studied their ffects.

With the report, the council also ask- d the B.B.C. to increase the number f television series from five to ten per veek starting in September, 1961.

EXPANSION PLANNED

Despite the many practical difficulties nvolved in doubling a service, which, apart from the actual production of pro- grammes, has to be planned in co-operation with the educational authorities to cover the whole school year effectively, the B.B.C. has stated its aim of advancing the date to September, 1960, and of broadcasting, in addition, telerecorded repeats of all programs.

Most, if not all, of the additional series asked for will start in September, 1960, and all by September, 1961, thus providing twice as many programs and four times as much viewing time for schools—making a total of 80 minutes daily from Monday to Friday.

In referring to the B.B.C.'s long record in sound radio schools broadcasts—which now number 55 a week and are taken by about 30,000 schools—the Director-General of the B.B.C., Sir Ian Jacob, said: "If school broadcasting is to be done at all, it must be done well. We are fortunate in having a network covering the whole country and we are determined to do the same good job in television as we have done in sound.

"We feel we have a great opportunity to go forward and make a real contribution to education, and we do not intend to let this opportunity slip."

MANY SCHOOLS

The number of schools in England, Scotland, Wales and Northern Ireland definitely known to have been viewing television schools broadcasts is 850, and the Senior Education Officer's Report gives the first thorough educational assessment to be made of their contribution to schools.

There is ample evidence that television has qualities which make its future in education secure—its capacity to assemble and give shape to a large variety of fascinating visual material, its up-to-dateness, its power to demonstrate clearly and effectively, its intimate and informal atmosphere of personal communication.

Its value extends far beyond what derives directly from the experience of viewing—in helping teachers to discover and develop unsuspected interests in their children, in sharpening children's powers of observation and critical faculties, and in providing teachers with a stimulus for their own teaching.

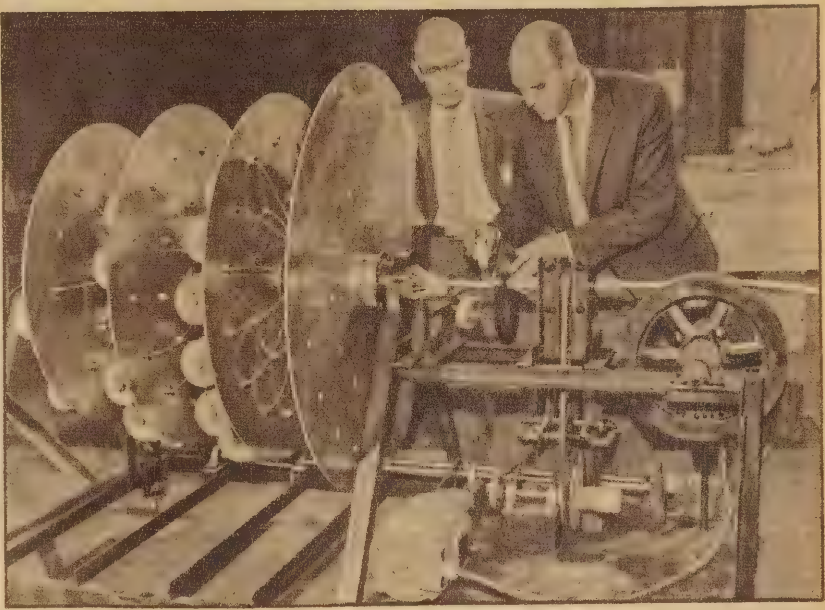
The television schools programs so far provided by the B.B.C. have been for children from 11 to 12 years of age in secondary schools, but there is clearly room for enlargement at each end of this age scale, and the B.B.C. is planning a new series for senior forms in Grammar schools and a miscellany program for younger children in primary schools.

A new science series designed to help the non-specialist teacher is also among the programs planned.

In discussing what help television can give to the non-specialist teacher — especially in view of the known shortage of mathematics and science specialists—the report points out that problems, both in education and broadcasting, differ in Britain from those in America, where the screen is often used to display techniques of the classroom, and suggests that in Britain the aim should be to bring into the classroom the full wealth and variety of illustration which television can provide.

The effectiveness of everything television can offer, the Schools Broadcasting Council stresses, depends ultimately on the classroom's teacher's imagination and skill.

MACHINE WINDS 84-WIRE CABLE



The developmental Centre of the Boeing Airplane Company in Seattle (U.S.A.) is producing flexible electric cables for Bomarc ground-launching equipment at a significant saving in time and cost over hand-winding with a novel "home-made" cable winding machine.

THE machine was designed, built and in production in just 30 days.

Historically, there is nothing very unusual about making flexible cable. It's been going on for years.

The interesting aspect, outside of the time and cost saving, is that only half a dozen or so manufacturers in the United States, all using machines of their own design, possess the highly specialised capability of mechanically combining several score wires into a single, compact electrical connecting unit that can be snaked along the ground with the ease and celerity of a vacuum cleaner cord.

The Boeing cable-winding machine, illustrated above, consists mainly of four aluminium discs, each of which carries its complement of gimbaled wire spools. The discs are mounted on varying sizes of steel tubing and driven in opposite directions by geared line shafts through chains and sprockets.

Threading of the machine is facilitated by quarter inch tubes running from each wire spool disc to the front of the machine. Proper lay of the cable is made by a 14in-diameter pulley at the front, which pulls the cable forward at the proper speed ratio to the rotating discs.

Two of the Boeing Airplane Company's Aero-Space Division Manufacturing research engineers, C. W. Wildebour and W. L. Dumar jun., participated in the development. The machine manipulates up to 84 strands of wire in a complex contra-helical lay—each lay spiralled in the oposite direction from its neighbouring layer beneath—to produce cable automatically taped as it emerges from the forming die.

Plans are under way for additional machines to expand the present cable-winding capability. Current production is limited to forming four-layer cables containing a maximum of 84 wires of No. 16 AWG or smaller, plus the core, to a maximum diameter of 1¼in at about 15ft a minute.

Waves don't just happen! Modern research is showing that their size and behaviour is a quite accurate measure of the forces which produced them.

Study Of Waves Is Becoming A Science

Waves of the ocean have a story to tell which is of great importance to the meteorologist, the captain of a ship, the fisherman and the p.anner of naval campaigns. Ocean waves have always held a fascination for people the world over.

EVERY summer crowds of people sit on the beach watching the waves; others swim in them, shoot the breakers, or just paddle on the edge.

People sit on cliff tops watching the waves crash against the shore, especially after great storms, and producing one of nature's greatest spectacles.

Waves can be marriage makers! What can be more romantic than to be with an attractive lass at the seashore on a moonlight night with the murmuring of the waves as a background for making love?

SMALL WAVES!

A fishing excursion at sea in a small boat can only be pleasant when the waves are small or the ocean swell is low.

When you load the boat with the prawn bait and bottles and the fishing lines and a demijohn and more bottles, baskets or hooks and sinkers and sandwiches, raincoats, knives, bottles, sunburn lotion, sea-sick tablets, cups and thermos flasks, corks, ropes, gaffs, bottles, mum, three kids, umbrellas, landing nets, bananas, old shoes and a change of clothing and bottles, you little realise how important it is that the waves should be just right.

For many centuries waves have had a story to tell. Natives on islands all over the globe have been able to deduce, from certain kinds of swells, the approach of heavy winds and storms.

Strangely enough, it is only in comparatively recent times that any effort has been made to make use of the story of the waves in a scientific manner.

When the science of hydrodynamics became recognised during the eighteenth and nineteenth centuries, the action of water and the principles of water movement and pressures stimulated men like Lord Kelvin and the famous Helmholtz to study the action of wind on the surface of water.

Results of their investigations led to further research by Dr Vaughan Cornis who found that the speed of waves wa directly related to the speed of the win which caused them.

by Calvin Walters

During World War II, when men an arms had to be landed on beaches a over the world, to the final great lan ing of allied armies in France, it becam of the utmost importance to be able t forecast the height of surf on th beaches concerned.

The re-fuelling and re-storing of ship at sea was a large-scale operation pa ticularly in the Far East and it was im portant that areas of least swell and di turbance be chosen for the task.

Then again, aircraft carriers were in operable in a heavy swell.

NORTH AFRICAN LANDINGS

During the landings in North Afric forecasts of the height and length o waves which would arrive at the beache were successfully made by Professo Sverdrup.

For the forecasts of wave condition on the famous D-day, a special divisio was formed at the British Admiralty This was called the Swell Forecastin Section. Its successful forecasts wer largely responsible for the success of th landings.

To gain some idea of the characte of ocean waves, it is worthwhile to ponder on the following definitions:

SEA is the actual disturbance of th water generated by the prevailing win and runs in the direction of the win blowing at the observer.

SWELL is a system of waves no generated by the prevailing wind at th site of observation but generated by a wind at some distance from the observer This wind could have been apparent days ago, some thousands of miles away.

LENGTH of a wave is the distance from the crest of the wave to the crest of the one behind it.

HEIGHT of a wave is the vertical distance of the crest above the bottom of the trough on either side.

The PERIOD of a wave is the interval between the passage of two successive crests past a given point.

WIND-WAVES ONLY

SPEED is the apparent rate at which the crests advance.

For our purposes we can ignore waves caused by earthquakes and submarine disturbances. We are concerned here with wind generated waves only, as these are the most important.

When a wind blows over the sea, downward moving eddies in the air stream press down on and disturb the surface of the water. It will readily be seen that if the pressure of the air stream varies, as it invariably does, trains of disturbances of varying characteristics will be generated on the surface of the water. These disturbances we call waves.

An interesting feature of a wave is the fact that the water itself does not move forward to any extent, although the wave itself advances.

It is predominantly the SHAPE of the

TABLES RELATE WIND, WAVES

TABLE 1. DURATION OF BLOW IN HOURS

WIND FORCE	6			12			24			48		
	a	b	c	a	b	c	a	b	c	a	b	c
5	3½	140	5	4½	180	6	5½	280	7½	7	380	8½
6	5	180	6	6	270	7	8	360	8½	10	530	10
7	7	250	7	8	360	8½	11	520	10	14	730	12
8	9	340	8	12	480	9½	15	680	11½	20	1000	14
9	13	450	9½	17	630	11	21	900	13	27	1300	16

TABLE 2. FETCH OF WIND IN MILES

WIND FORCE	50			100			200			500		
	a	b	c	a	b	c	a	b	c	a	b	c
5	3½	120	5	4½	180	6	5½	250	7	7	360	8½
6	5	140	5	6	250	7	7	320	8	9	450	9½
7	7	180	6	8	330	8	10	400	9	12	500	10
8	9	250	7	11	400	9	13	520	10	17	700	11½
9	12	300	7½	14	500	10	17	650	11	22	900	13

(a) height in feet. (b) length in feet. (c) period in seconds.

The tables above give the average wave dimensions for given wind forces and a few Durations or Fetches respectively. Under particular circumstances, the waves generated will be those from the table which gives the smaller length and period. For example, a wind force 8 blowing over a fetch of 100 miles for six hours will generate waves nine feet high, 340 feet long, and with eight second period: their size is limited by lack of time. After 12 hours, they will have grown to 11 feet high, 400 feet long, and nine second period, representing maximum size.

ave which advances. The water par les describe an approximate circle oving forward in the crest, backward the trough, upward in the approaching crest and downward in the receding est.

This rotating motion of the water par les creates friction which tends to re ice the height of the wave. However, though the water particles do not ove forward appreciably, they do not turn exactly to their former position it to a position slightly forward in the irection which the wave is travelling. his action creates a weak current in the irection of travel.

CIRCULAR MOTION

If you watch particles of matter in wave this circular motion can be bserved. It is considerably reduced ith depth so that a submarine is not ffected by storm waves and does not ave to dive very deeply to get out of hese wave disturbances. At a depth of nly one-ninth of the wavelength the ircular motion is reduced to one half f that at the surface.

Needless to say, the greater the force f the wind the more severe its effect n the water will be, so that the various haracteristics of a wave reveal the haracteristics of the wind which generated it.

When the wind exceeds 10 knots the orce pushing on the rear slope of the rests with a partial vacuum in front ffects the wave.

The wave will gradually increase in eight, length and speed until its speed pproximates that of the wind—a process which may take several days to ring about. When it has been attained the wave characteristics remain the ame for as long as the wind persists.

If the wave meets no opposition from tides, strong currents or opposing winds it will travel a long way. The longer the wavelength of a wave the faster it will travel and the longer life it has.

There is a peculiar effect which it is important to note here. It can best be demonstrated by dropping a stone into a pool and watching the group of rings produced.

SPEED OF TRAVEL

You will notice first that the waves with the longest wavelengths are on the outside. The wavelengths are shorter nearer to the centre.

In other words, waves with the longest wavelength travel faster than the shorter ones and arrive at the outside first.

The same happens in a storm. The storm generates a variety of wavelengths, but the longer ones move faster with the result that they arrive at the shore first in a long, low swell.

The short waves will arrive later and the difference in the time of arrival of both sets of waves enables the distance of the storm to be calculated.

Another important factor is that a group of swell waves travels at only half the speed of any individual wave in the group. Now this may be difficult to understand until you consider the following:

Look again at our ring of waves produced by a stone in the pond. If you keep your eye on a wave at the centre of the ring you will notice that it travels right past the other waves, through the ring, disappearing on the outside. In other words the speed of the individual wave is greater than the group.

It can only be deduced that the group of waves carries the energy of the waves which moves at less speed than the crests of the waves.

This is very important, for it has been found that, in sea water, the swell travels at approximately half the speed of the wind which generated it. So that if a weather chart indicates that long waves are being generated in a particular area and are moving towards a place in which a person is interested, it is possible to calculate approximately when the swell will arrive.

Another important discovery is that waves lose half their height every time they travel a distance in miles equal to their wavelength.

Observations over a period of time have enabled a scale to be formed of the character of waves formed by winds of varying forces travelling for varying periods of time over varying distances. These scales are reproduced here and will be found rather informative.

The likely force and behaviour of waves is of vital interest, also, to engineers charged with constructing breakwaters and retaining walls.

See and hear the fabulous

Wall of Sound

at J. & E. Myer

MASTERSOUND SALES

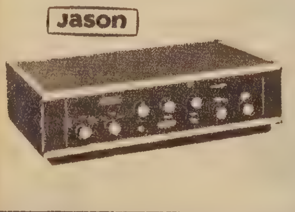
Direct Importers and Distributors of the world's finest hi-fi equipment.

At last! A high-fidelity specialist with really adequate facilities for auditioning and comparing various combinations of Hi-Fi equipment comes to Sydney. Mastersound's fabulous Wall of Sound enables you to choose (strictly by ear) from a combination of up to 18 concealed speaker systems, each mounted in its correct enclosure. In this way selection is completely unbiased and you will take home the speaker YOU felt was the best, not simply the one with the best name.

This showroom is a sincere attempt to please everyone who enjoys first-class sound. We have tried to create an atmosphere in which both technical and non-technical listeners and their wives will feel at ease. A good Hi-Fi system should be a handsome addition to the best room in the home and need be neither expensive nor bulky. Come in and see for yourself.

TO
GEORGE
STREET
STREET
396
KENT STREET
MARKET

396-404 Kent Street, Sydney.



Jason J2-10 Mk. 3 Stereophonic Amplifier
British-made ultra-linear Stereo Amplifier, delivering 10 watts per channel at 0.1% distortion or 15 watts per channel sine wave. Input 5 mv. for full power. Noise level better than 60 db. Operates direct from finest pick-ups (e.g., Decca) and tape heads. Printed circuits. High and low pass switched filters. Full price, 85 gns., including sales tax.

Jason J TV/2 F.M. and TV Sound Tuner
Unique self-powered tuner for Sydney's F.M. station **plus** the sound from TV channels 2, 7 and 9; thus virtually creating four F.M. Stations. Full price, 43 gns., including sales tax.

Myer Stereo Amplifier
Complete hi-fi stereo amplifier powered at 5 watts per channel, 10 watts combined, for crystal pick-ups. Separate ganged bass and treble controls, independent channel balance. Measured response 20-40,000 ± 2 db. Full price, 50 gns., including sales tax.

Tannoy "Monitor" Dual Concentric Loudspeaker Systems
Used by world's leading recording studios. New model features Tannoy Magnetic Shunt, greatest advance in design of recent times. Overall response 20-20,000 cycles via 12 db. per octave crossover network. Full price, complete with crossover, £78/10/-, including sales tax.

The distance over which the wind is ble to act in the same direction is calld the "fetch" and has an important bearing on the character of the generated waves as can be seen from the able.

Being a wave phenomenon, ocean waves conform to the same laws as light waves namely refraction, reflection and diffraction.

These are particularly noticeable in waves near the coast. Refraction is brought about by the effect of the sea floor. When the depth of the water is ess than half the wavelength of the wave refraction or change of direction takes place. The end of the wave near the beach is slowed up and the wave swings round until it runs parallel to the beach.

Reflection or reversal of a wave can often be seen when it meets some obstacle such as a jetty or very steep beach or cliff. The wave is completely reversed and travels backwards.

WAVE DIFFRACTION

Diffraction can be seen when the wave passes the end of an obstacle such as a breakwater or jetty. The wave changes direction and dies out.

It is the refracted wave which brings the breakers so much sought after by the surfer.

As the depth of water decreases to less than one half the wavelength of the wave, the length and speed of the wave becomes less and the waves become telescoped as it were. The height remains the same, but the waves become steeper until the angle formed between the rear and front slopes is less than 120 degrees, when the wave becomes unstable.

When the depth of water is one and a half times the height of the wave the latter will break. If one can estimate the height of the wave when it breaks, the depth of water is half as much again, so that a wave 6ft high from trough to crest will have nine feet of water beneath it. This calculation would be handy to mum when she is anxiously watching her children in the surf.

As is well known, there are two main types of breaker. The plunging breaker and the spilling breaker.

The well-known "dumper" is a plunging breaker, where the crest plunges vertically downwards. The spilling breaker is one where foam on the crest rises steadily over the wave.

PLUNGING BREAKERS

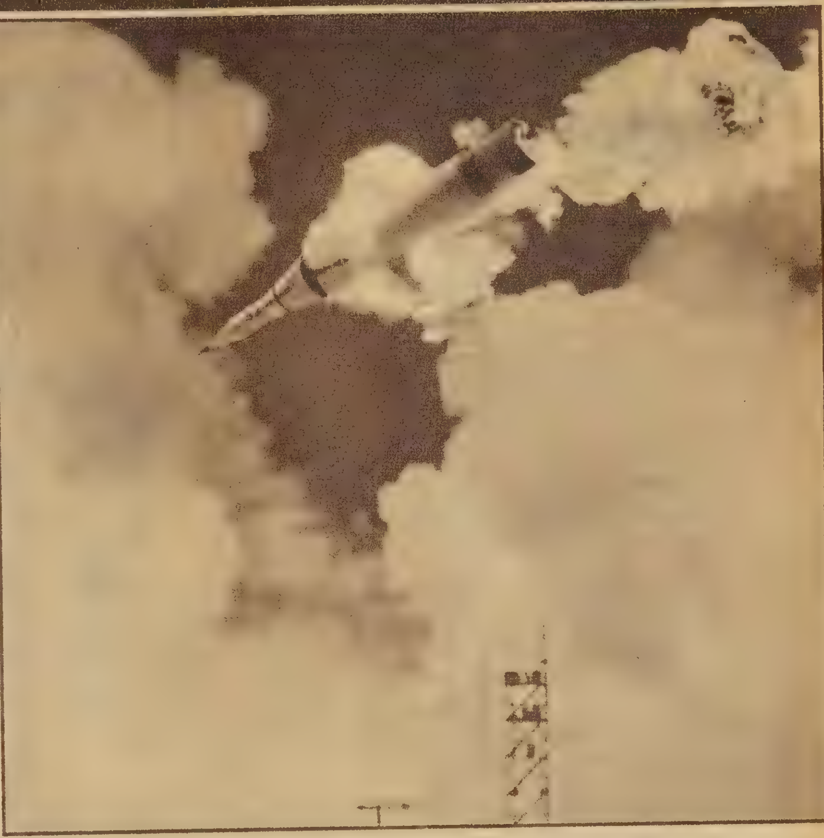
When a plunging breaker occurs, it results from regular slow swells breaking on a smooth bottom whilst the spilling breaker results from steep waves with strong winds blowing from the sea.

Storms at sea generate wave systems with wave trains of differing wavelengths travelling in all directions.

The so-called "white horses" are formed when the crests of a number of waves coincide, producing a wave large enough to break. When the waves get out of phase the white horses are no more. These white horses have a greater chance of being produced the stronger the wind and the larger the various waves.

In estimating wind speed, experienced men sometimes count the number of white horses over a period and use this as a guide.

WHEN SPACE ROCKET RUNS AMOK



Why blockhouses are necessary at launching sites needs no further explanation. A Juno II rocket is here shown being exploded by the Range Safety Officer just after it left the launching pad and commenced to run wild.

The breaking of waves in very deep water is governed by a different factor from the breaking wave on a beach. In deep water it is the steepness which is the governing factor.

The longer the wavelength the greater the energy it contains because it must have been produced by a strong wind. Therefore the greater the wavelength the steeper the wave. It has been estimated that a wave with a wavelength of 500ft can theoretically be 70ft high, although this has not been observed in practice.

The highest wave recorded to date was 60ft high. Such waves contain enormous amounts of energy, the harnessing of which has been a matter of considerable thought to scientists for centuries.

Wave forecasting, as can be imagined, is very important in applications such as the building of sea walls, breakwaters and artificial harbours. The drilling of oil wells in the sea requires calm waters whilst the fisherman is extremely interested in the condition of the sea.

Prior to World War II most of these activities were dependent on forecasts based on hit-or-miss methods.

A new application of wave forecasting is the finding and plotting of shipping routes which are comparatively free from strong wave and wind conditions. As more information comes in, the experience gained can be used to plot these shipping lanes which, aside from the economy resulting from smooth runs, will be more comfortable for passengers aboard.

The principal method used for forecasting wave conditions at a given point is the use of underwater detectors. These take the form of pressure measuring instruments on the sea floor at depths ranging from 10 to 100ft.

These instruments are connected electrically to moving graph pens located on shore.

DEPTH OF WATER

It can easily be seen that the pressure on the instrument is dependent on the depth of water above it. Therefore when waves pass overhead the pressure will vary according to the height of the wave.

The recording pen produces a continuous graph which, of course, shows not only the pressure which can be converted into terms of height but also the period of the wave.

The graph is in fact a composite picture of all the wave trains passing overhead and must be converted into a picture which is an analysis of wave conditions. Allowances have to be made for several factors.

By working backwards from the record the scientist is able to determine how far away is or was the disturbance which generated the incoming waves.

Greater difficulty was met in using a

(Continued on Page 85)

JACOBY MITCHELL
EQUIPMENT FOR INDUSTRY AND RESEARCH

THE PORTASCOPE 300
by bwd

Y AMPLIFIER/ SENSITIVITY

DC — 10 mc/s (— 3db) at 1v P/P
DC — 3 mc/s (— 3db) at 300 mv P/P
DC — 1 mc/s (— db) at 100 mv P/P
Risetime .035 u sec.

TIME BASE

100 m sec/div — 1 u sec/div
Trace Expansion continuously variable to 3 diameters

TRIGGERING

Automatic triggering

CRT

2¾" type DH7/41 or 3 MFP
E.H.T. 1 K.V.

DIMENSIONS

9" x 6¼" x 13" (overall)

WEIGHT

18½lb

The PORTASCOPE 300 introduces to the Australian engineer and technician a compact, high performance Oscilloscope that will meet exacting standards whilst retaining the advantage of low initial cost.

In particular, the facility of a balanced input, together with those of wide bandwidth (— 3db at 10 Mc/s), and direct coupling, will appeal to many users.

The latest type of high sensitivity C.R.T., operating at 1.0KV, and having an extremely high light output, is fitted, and this, in turn, is enhanced by a suitable contrast filter

Full specification on request to our Showrooms and interstate distributors.

£86/5/-
plus Sales Tax
Sydney—Melbourne
(Other States slightly higher).

JACOBY, MITCHELL & CO. PTY. LTD.

469-475 KENT STREET, SYDNEY. (MA8411)
MELBOURNE Office: 113 Bridge Rd., Richmond. (JB5100)
NEWCASTLE Office: 135 Belmont St., Hamilton. (MA4744)
AVAILABLE FROM ALL DISTRIBUTORS

Technical Review

SOME RECENT ADVANCES IN MEDICAL ELECTRONICS

From being a more or less haphazard off-shoot of electronics generally, the field of medical-electronics is rapidly expanding into a complete, composite science. The following article outlines some of the lectures presented at the Second International Conference on Medical Electronics, held in the Unesco building in Paris.

ONE afternoon recently, on a lecture platform in Paris, Dr H. G. Noller, of Heidelberg, did the unusual thing of opening his mouth and swallowing a small radio transmitter. He then proceeded to track its course through his body with a radio receiver.

This was, in fact, a demonstration of the "radio pill," or endoradiosonde, technique for measuring pressure and other parameters from inside the gastrointestinal tract for the purposes of medical examination.

Dr Noller's demonstration drew attention to the advanced nature of the modern techniques which now form the subject of medical electronics.

A few years ago medical electronics hardly existed as an integrated field of study. There were a few isolated centres of activity, such as electro-cardiography, electro-encephalography, and radiography, with very little common ground between them.

Nowadays electronic techniques have proliferated to such an extent that doctors, physicists and technicians from many different branches of medicine and many different countries have found a great deal in common, and for two years running have met at international conferences in Paris. A third international conference is to be held in London next year.

INSIDE THE BODY

To a non-medical technician one of the most interesting aspects of the techniques described at UNESCO was the possibility of carrying out measurements, or performing therapeutic operations, by electronic units actually implanted inside the body. The endoradiosonde, though not exactly implanted, was a notable example.

Another was the self-contained "pacemaker" for the heart described by the Swedish workers R. Elmqvist and A. Senning.

Electronic pacemakers are essentially pulse generators used as muscle stimulators to ensure the correct beating of the heart. They often have to be used for long periods after cardiac surgery has caused some damage to the heart muscles.

The conventional technique of applying stimulation through a cable brought out through the skin brings with it a risk of infection; hence the need for a self-contained device which can be sterilised and sealed inside the body.

The Elmqvist and Senning pacemaker is a transistor blocking oscillator followed by a transistor amplifier which feeds the stimulating electrode through an RC network. It delivers 2-volt pulses of 1.5msc duration at about 80 pulses per second.

The source of power is a small nickel-cadmium accumulator consisting of two 60mAh-capacity cells. This is kept charged from outside the patient's body by a magnetic induction system, using a 150kc/s AC generator feeding a large diameter coil and a small pick-up coil and rectification circuit in the pacemaker.

BELOW BREASTBONE

The pacemaker is actually implanted subcutaneously in the part of the stomach just below the breastbone.

Another example of inductive connection to an implanted device was in the technique of direct electrical stimulation of the auditory nerves of deaf people, described by A. Djourno of Paris. The essentials of this method, in which a small pick-up coil is implanted inside the head, were outlined by Dr Djourno at last year's conference.

The main limitation of the early experiments was that the same group of nerves in the brain was stimulated whatever the form of the induced signal, so that auditory sensations in the human subject were restricted to the strength and rhythmic pattern of the stimulus: different frequencies, or components of frequency, in the stimuli could not be distinguished.

The discrimination of frequencies depends on the fact that each frequency causes a different group of auditory nerve fibres in the brain to be activated, so at least two spaced sources of stimulation are required to obtain such discrimination.

At this year's conference Dr Djourno expressed the opinion that with two implanted pick-up coils it would certainly be possible for a subject to identify a large number of frequencies—not just two.

Each coil could be energised with a strength which was some function of the frequency, so that any given frequency would produce a particular combination of amplitudes in the two coils. Subjectively this combination of stimuli would come to mean the said frequency to the patient.

Experiments on stimulating the left and right legs of a frog with pick-up coils and tuned energising coils had shown that a wide variety of different effects (in this case physical postures) could be obtained with different signal frequencies.

FLOW OF BLOOD

A paper by T. Posteli, G. C. Garbini and G. Azzolini (Italy) described a small photoelectric pick-up device which had been implanted experimentally in animals for measuring the volume of blood in blood pulsations (by their varying density to light) in the visceral arterial system.

Measurement of the rate of flow of blood from the heart by an implanted flow-meter was described by F. Olmsted (U.S.A.). This technique made use of the type of electromagnetic flowmeter in which the blood flows through a magnetic field and, acting like a moving conductor, generates a voltage across a section of the blood vessel proportional to the rate of flow.

Both of these implanted devices, however, required connections passed through the skin of the subject.

Returning to the endoradiosonde, the particular example described by Dr Noller measured only 10mm by 4.5mm (diameter) and was claimed to be the smallest ever made. It is manufactured on an industrial scale and so can be treated as an expendable item.

Another, slightly larger, endoradiosonde was the subject of a paper by B. Jacobson of Stockholm. Measuring 18mm x 8mm (diameter), it contains a transistor oscillator working at 350 Kcs, powered by a 1.2-V nickel-cadmium storage cell.

Pressure changes in the alimentary canal cause movements of an iron core in the oscillator tank coil, thereby modulating the frequency of the oscillator. The sensitivity of the device is expressed as 15 Kcs frequency change per centimetre of water pressure.

The dipole aerial is in the form of a surrounding electrostatic screen, which

TD-124
£61/10/-

TD-124L
£70/-/-

WHAT MAKES THE TD's TOPS?

. . . finer for stereo . . . finer for mono

If you move in circles where component hi-fi is a by-word, you've no doubt heard about the Thorens TD-124 transcription turntable and its fabulous performance. But for late-comers we'd like to point up just a few of the really big features (non-technical readers may skip remarks in parentheses). ● Extra heavy table for constant speed (10lb rim-concentrated table insures low wow and flutter; higher moment of inertia than any similar table). ● Exact speed plus-minus 3% adjustment on all speeds — 16 2/3, 33 1/3, 45, 78 — with built-in illuminated strobe for setting after stylus is on record). ● Easy on records (unique two-table design permits starts after you've placed stylus, permits 2/3 rev. starts, makes cueing easy). ● Extremely low rumble (mirror-finish mainbearing, nylon-seated ball-thrust-bearing reduce both vertical and horizontal rumble to a new low, so important for stereo). ● 2-way motor rumble reduction (both an extra-large idler and an ultra-compliant belt-drive keep motor vibration and speed variations from table). ● Driving parts electronically balanced. No costly base necessary. 50 cycles, 250 volt operation.

These are just a few of the TD-124's features. Ask your dealer to tell you the whole story on the fabulous TD-124.

Now two budget-priced TD turntables

TD-134L, £35/10/.

These 4-speed turntables have same basic adjustable-speed precision-drive as famous TD-124 but you save two ways. (1) They come already equipped with stereo-wired professional arm without overhang making them ideal changer replacements. (2) Some TD features have been eliminated to save you money. But they still top the performance of every similar turntable and player on the market. TD-184L has semi-automatic operation. TD-134L is manually operated. Precision metal stroboscope (50 cycles) furnished with each unit. 250 volt operation.

TD-184L, £43/10/.

THORENS

For those who appreciate the difference

Also Available: General-Electric Stereo and Mono pick-up cartridges.

Distributed throughout Australia by

Fidelity AE
Audio Engineers PTY. LTD.

contact your local dealer

revents varying stray capacitances to the ody organs from affecting the oscillator equency.

The principle of applying artificial aids) inoperative organs (known as prostheses), as exemplified by Dr Djourno's work on hearing, came up again in a paper on artificial muscles by L. H. Montgomery and S. E. Stephenson (U.S.A.). Here the idea is that the nonfunctioning muscles are replaced by mechanical devices which are controlled naturally from the nervous system by amplified muscle potentials.

Originally the technique was developed for assisting the respiration of polio patients. It is now being tried out experimentally as a possible aid for extremities of the body such as the hands and arms.

MUSCLE POTENTIALS

In the example shown in the photograph, muscle potentials picked up by electrodes on the arm are amplified and used to operate an electro-mechanical valve controlling the flow of compressed gas from a cylinder. Muscle potential pulses are thereby converted into gas pressure pulses.

These pressure pulses pass into the mechanical muscle itself, which consists of a rubber tube covered with a woven sleeve of fine steel wires. When the gas pressure causes the tube to expand radially the angle of the weave is altered and the sleeve is contracted longitudinally, thereby operating the mechanical brace system.

Several interesting developments in the field of radiography were described. One paper, by S. Aronow (U.S.A.), dealt with scanning devices based on the emission of positrons (positive electrons) from radioactive isotopes.

The isotopes are combined with certain chemicals which/ are selectively absorbed by foreign growths such as tumours. By geometrically scanning the radioactive area of the body with radiation detectors and automatically plotting the intensity distribution, the size and position of the tumour can be determined.

Here, the particular advantage of positron emission is that it enables greater precision of plotting to be obtained than is possible with other penetrating rays. When a positron is emitted it combines almost immediately with a (negative) electron and produces two quanta of gamma radiation, which travel in opposite directions (180 deg. apart).

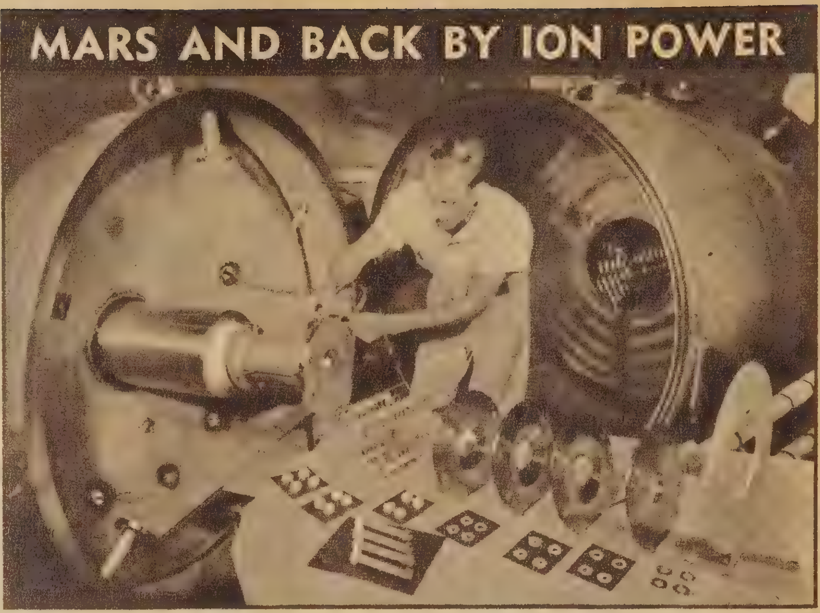
TWO DETECTORS

If two detectors are placed on opposite sides of the radioactive area, and only those signals which arrive at both in precise time coincidence are recorded, a high degree of spatial collimation can be obtained.

Solid-state light amplifiers for X-ray fluoroscopy, based on photoconductive and electroluminescent layers, were the subject of a paper by B. Kazan (U.S.A.). Experimental panels measuring 12in x 12in have given images 100 times brighter than those obtained from conventional fluoroscope screens.

In another paper, F. Shimazu, S. Miura and K. Fujimoto (Tokyo) described an electronic control system by which X-ray photographic exposures of the heart could be made at predetermined instants of the cardiac cycle. The device is triggered by a characteristic spike-wave potential picked up from the heart, and a variable-delay timer and c.r.t. monitoring system allow the instant of exposure to be set precisely with respect to this spike.

MARS AND BACK BY ION POWER



A technician assembles a research model of an ion engine—a type of electronic power plant that may some day carry man to Mars and back. This picture was made at the National Aeronautics and Space Administration's research centre at Cleveland, Ohio. The engine operates with cesium as a propellant.

A whole session on the applications of ultrasonics revealed that ultrasonic energy is being used not only for echo-sounding exploration of the heart and brain, but for producing scanned images of the density distribution of internal organs and for therapeutic destruction of spurious bodies like gall-stones.

The principle of the ultrasonic telescope, as an alternative to radiography for obtaining images of internal structures, was outlined by C. N. Smyth at last year's conference.

This year the development of a similar ultrasonic image converter was described by W. Freitag, J. Martin and G. Schellbach (Germany). The device is basically an iconoscope television-camera pick-up tube, with a quartz plate sensitive to ultrasonic energy instead of a photo-electric plate sensitive to light energy.

Ultrasonic waves falling on the quartz plate in a particular intensity distribution produce a corresponding pattern of piezo-electric potentials on the plate. These potentials modulate a flow of secondary electrons from the plate to a collector electrode, the flow being produced by bombardment by primary electrons from an electron gun scanning the plate in conventional television fashion.

TV TYPE DISPLAY

The collector (which is screened from the direct influence of the piezo-electric potentials) then gives a signal which is used to modulate the brightness of a synchronised c.r.t. monitor, thus giving a television-type picture of the ultrasonic energy distribution.

Ultrasonic "lithotresis" is the name given by one group of workers to the use of ultrasonic energy for disrupting stones in the biliary and urinary tract.

Early attempts at beaming the energy from a source outside the body were unsuccessful because of the power required and the susceptibility of the intervening body tissues to damage.

H. Lamport and co-authors described a method by which the ultrasonic energy is conducted directly to the stone by a solid transmission line and drill tip through a catheter (a thin flexible tubular device used for passing along narrow tracts in the body).

This transmission line consists of flat ribbons of Monel metal which are flexible in one direction so that they can follow the bends of the catheter. The length of the line has to be precisely related to the wavelength in order to obtain maximum transfer of energy from the magneto-striction generator, which operates at 20kc/s.

PARTICLE COUNTING

Among several papers on particle counting and sizing techniques, probably the most significant one medically was that given by R. C. Bostrom, H. S. Sawyer and W. E. Tolles (U.S.A.) on an automatic instrument, called a cyto-analyser, for rapid "screening" of samples of human tissue to detect the presence of cancer.

The device works on the principle of measuring the areas of cell nuclei, using a mechanical-optical scanning system and electronic circuits similar to those of a digital computer. Samples of cells are automatically classified as normal or abnormal, to indicate whether the human subject requires further examination.

The rapidity of "screening" by the electronic method may eventually make possible the examination of whole sections of the normal "healthy" population, rather like mass radiography, so that symptoms of cancer can be discovered before the disease reaches the incurable stage.

Compare

the RANGE!
the PRICE!
the QUALITY!

of these . . .

National

POWER TRANSFORMERS

Type	mA	H.T. Volts (A.C.)	Filament Ratings	DIMENSIONS					
				UPRIGHT			FLAT		
				Height	Width	Depth	Height	Width	Length
U or F30/150	30	150/150	6.3v/1.7a	2⅝	2 3/16	2	1⅝	2 3/16	2⅞
U or F40/150	40	150/150	6.3v/2a	2⅝	2 3/16	2⅛	1½	2 3/16	2⅞
U or F40/285	40	285/285	6.3v/2a 5v/2a	3⅛	2 13/16	2⅜	1¾	2 13/16	3⅜
U or F40/325	40	325/325	6.3v/2a 5v/2a	3⅛	2 13/16	2⅝	1⅞	2 13/16	3⅜
U or F50/225	50	225/225	6.3v/2a	3	2½	2¼	1½	2½	3
U or F60/285	60	285/285	6.3v/2a 5v/2a	3¼	3⅛	3⅜	2¼	3⅛	3½
† U60/300	60	300/300	6.3vct/1a 6.3v/1a	3½	3⅛	2½	—	—	—
U or F60/325	60	325/325	6.3v/2a 5v/2a	3½	3⅛	3¼	2⅜	3⅛	3½
U or F60/385	60	385/385	6.3v/2a 5v/2a	3½	3⅜	3½	2½	3⅜	3½
* U80/250T	80	250/250	6.3v/2a 5v/2a	3½	3⅛	4⅛	—	—	—
† U80/250	80	250/250	6.3vct/2a 6.3v/.6a	3½	3⅛	2½	—	—	—
U or F80/285	80	285/285	6.3v/2a 6.3v/2a 5v/2a	3¾	3⅛	4⅛	3⅛	3⅛	3½
† U80/300	80	300/300	6.3vct/2a 6.3v/.6a	3½	3⅛	4	—	—	—
U or F80/325	80	325/325	6.3v/2a 6.3v/2a 5v/2a	3½	3⅛	4⅛	3	3⅛	3½
U or F80/385	80	385/385	6.3v/2a 6.3v/2a 5v/2a	3½	3⅛	4⅛	3⅛	3⅛	3½
U or F100/285	100	285/285	6.3vct/2a 6.3v/2a 5v/2a	4½	4⅛	3½	2¼	4⅛	4½
U or F100/325	100	325/325	6.3vct/2a 6.3v/2a 5v/2a	4½	4⅛	3⅞	2⅜	4⅛	4½
U or F100/385	100	385/385	6.3vct/2.5a 6.3v/2a 5v/2a	4½	4⅛	3⅜	2⅜	4⅛	4½
U or F125/285	125	285/285	6.3vct/2a 6.3v/2.5a 5v/2a	4½	4⅛	3⅝	2⅝	4⅛	4¾
U or F125/325	125	325/325	6.3vct/2a 6.3v/2.5a 5v/2a	4½	4⅛	4⅛	2⅜	4⅛	4¾
U or F125/385	125	385/385	6.3vct/2a 6.3v/2.5a 5v/3a	4½	4⅛	3⅞	2½	4⅛	4½
† U150/250	150	250/250	6.3vct/4a 6.3v/1a	4⅛	3 7/16	3¼	—	—	—
U or F150/285	150	285/285	6.3vct/2a 6.3v/2.5a 5v/3a	4½	4⅛	4⅜	3⅛	4⅛	4½
U or F150/325	150	325/325	6.3vct/2a 6.3v/2.5a 5v/3a	4½	4⅛	4	3	4⅛	4½
U or F150/385	150	385/385	6.3vct/2a 6.3v/2.5a 5v/3a	4½	4⅛	4⅜	3⅜	4⅛	4½
U175/425	175	425/425	6.3vct/3a 6.3v/2a 5v/3a	4½	4⅛	4⅝	—	—	—
• U180/305	180	305/305	6.3vct/4a 6.3v/4a 5v/2a	4½	3¾	5⅛	—	—	—
† U180/410	180	410/410	6.3vct/4a 6.3vct/2.5a 5v/3a	4½	3⅜	4⅜	—	—	—
• U190/127	190	317VDC	6.3v/7.5a	3¾	3⅛	4⅛	—	—	—
U200/385	200	385/385	6.3vct/3a 6.3v/3a 5v/3a	4¾	4⅛	5¼	—	—	—
U250/385	250	385/385	6.3vct/4a 6.3v/3a 5v/3a	4¾	4⅛	5¼	—	—	—

* Low-field Tape Recorder Transformer

† Designed Specifically for Mullard circuits

■ Designed Specifically for R.T. & H. circuits

- UPRIGHT OR FLAT—indicated by prefix U or F.
- PRIMARY—230, 240, 250 volts.
- COVERS—are fitted to all Transformers above 50mA. Details of other types available on request.

POST COUPON

Australian and Overseas Agents:
Wm. J. McLELLAN & Co. PTY. LTD.,
126 Sussex St. (near King St.), Sydney. BX1131.
VICTORIAN AGENTS:
Australasian Engineering Equipment Co. Pty. Ltd.,
476 Latrobe St., Melbourne. FY2638.
FACTORY REPRESENTATIVES:
Queensland: K. H. Dore and Sons, Brisbane. B0268.
South Australia: B. L. Andrew and Co., Ltd., Adelaide. W1827.
Western Australia: I. W. Holman, Perth. BA8190.

Please forward me details on National Power Transformers☐ Filter Chokes☐ Stepdown Transformers☐ TV Transformers ☐

NAME ....

ADDRESS ....

SUPPLIER (optional) .... R.H. 12/59

ELECTROSTATIC UNIT PRINTS PHOTOGRAPHS DRY

A prototype electrostatic printer makes inexpensive finished pictures in seconds from photographic negatives. The machine has been developed by Haloid Xerox Inc., for the U.S. Air Force.

The device produces finished, positive, continuous-tone pictures on white unsensitised paper at the rate of 20 ft/min, making a 9 x 9 inch print every 2¼ sec.

Under combined sponsorship of the U.S. Air Force and Signal Corps, the machine was contracted for and technically monitored by the Aerial Reconnaissance Laboratory, Wright Air Development Centre.

The machine operates on the principles of xerography, making continuous-tone pictures in a machine in daylight and without chemicals or sensitised paper.

CONTINUOUS PROCESS

In one continuous cycle, the unit exposes, prints and finishes dry, positive pictures from a 500ft roll of negative film up to 9in wide.

With a simple adjustment, positive pictures can be made from positive film equally well.

In this model, finished prints are the same size as the negatives. Prints could be enlarged or reduced with addition of a projection optical system.

The xerographic drum in Fig. 1 is coated with a thin layer of photo-sensitive selenium charged positively. The roll of negative film is fed into moving contact with the rotating drum and exposed by a slit of light at the line of contact.

A finely dispersed (0.3-micron) charged black powder is sprayed against the drum. Portions of the drum shaded by dark areas of the film retain their electrical charge; portions covered by clear areas of the film are discharged.

When negatives are printed, the charged dry powder is attracted to the uncharged areas on the drum, and repelled from the charged areas, making the latent image visible.

The powder image is brought in contact with a roll of plastic-coated white paper which is charged electrically to attract the powder from the drum. The powder is bonded tightly to the paper by briefly applying heat to soften the plastic. The image thus becomes permanent.

The new machine is designed primarily for use in high-speed, high-volume printing from aerial film for mapping and reconnaissance purposes.

RAPID VIEWING

The finished prints may be viewed a few seconds after picture making begins and rapid modifications of contrast and exposure made continuously while the machine is running.

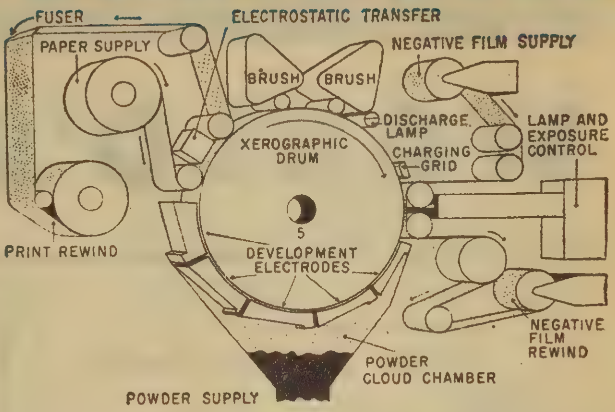
A knob, calibrated to correspond to the various grades of conventional photographic papers, controls the amount of electrical charge sprayed on the photosensitive drum.

Thus modified exposures and contrasts are possible before substantial quantities of material have been processed and wasted, if adjustments were not correct.

Unlike conventional photographic emulsions, xerographic plates and drums are not affected by gamma and neutron radiation, except during the moment before exposure. In this moment, the xerographic surface is made sensitive by electrostatic charging, and is then processed so quickly that the prints are unaffected.

Prints having resolutions of 750 lines/in. can be made routinely; twice that has been attained.

Maximum density of the present xerographic pictures is not quite equal to that achieved on conventional photographic papers. However, it is anticipated that before broad acceptance is sought, further progress will be made. — From "Electronics."



Charged photo-sensitive selenium is used in machine to produce pictures continuously from roll of film negative.

CONVAIR SHOWS JET TRANSPORT

The Convair 880, claimed to be the fastest jet transport yet built, is shown below as it climbs to operating altitude after takeoff from Lindbergh Field in San Diego, California, on its maiden flight.

AFTER an hour and 14 minutes in the air, the swept-wing, gold and white airliner landed at the U.S. Naval Air Station at North Island, where it was based for the first 10 hours of its flight test program.

Capable of a maximum cruising speed of 615 miles an hour, the new transport is being built for airlines both in the United States and abroad by Convair Division of General Dynamics Corporation at San Diego. Designed for operation from any airport now accommodating four-engine piston powered transports, the new 880 used less than half the 8,100ft runway at Lindbergh Field on its first flight.

The 880 is currently powered by four General Electric CJ-805-3 jet engines—commercial version of the J-79 engine that powers Convair's Mach 2 B-58 U.S. Air Force bomber. However, the ultimate choice of engine may be influenced by the recent announcement by G.E. of two turbofan types.

General Electric's aft turbofans utilise all of the basic major components of the proven CJ-805-3 conventional turbojet with the addition of an aft-fan component. The aft fan enables the engine to perform at best cruise efficiency in the Mach .80 to Mach .95 speed range with a sharp decrease in specific fuel consumption over conventional turbojet gines.

The aft turbofan is now in its second year of an exhaustive test program at General Electric.

GOODMANS

WORLD'S FINEST

Does space for stereo worry you?

AXIETTE II (8") IS YOUR ANSWER

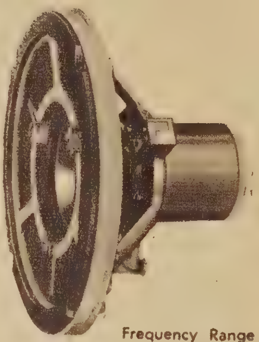
For the discriminating listener requiring a full frequency range single-cone, high-fidelity loudspeaker—at an attractive price—the Axiette II fulfils the space-saving demand and brings perfection, with an extensive, well-balanced frequency coverage.

Flux Density .... 15,000 gauss
Frequency Range .... 40-15,000 c/s.
Fundamental Resonance 65 c/s. (nominal)
Maximum Power Handling .... 15 watts
Impedance .... 16 ohms

Price: £16.

Craftsmanship with audio perfection and notable "free-edged" suspension.

AXIOM 80 (9½")



Capable of the highest accuracy in sound reproduction at medium power levels is this twin-cone transducer. Suspension of the moving assembly on two sets of double-acting cantilevers has provided extremely low — and linear — axial stiffness with a powerful radial-centering action.

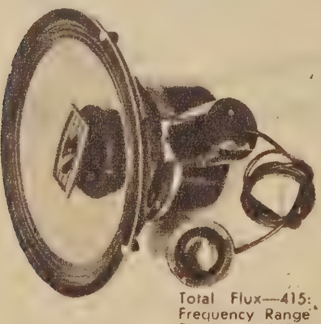
This unit is hand built throughout.

Frequency Range .... 20 c/s.-20,000 c/s.
Max. Power Handling Capacity: 6 watts
Flux Density .... 17,000 gauss
Impedance .... 15 ohms
Total Flux Density .... 62,000 maxwells

Price: £36/14/6.

More advanced than to-morrow's news—

TRIAXIOM 415 & 615 (15")



These Triaxial high-fidelity loudspeaker units each have three separate specialised radiators — integrated within one precision unit.

Special features include:—

Free-edged, low-frequency diaphragm—plastic terminated—precision controlled.

Extra length in the 3" diameter voice coil provides high efficiency.

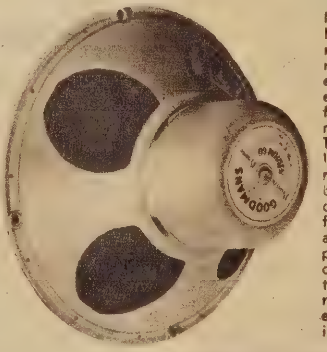
High-stability, mid-range radiator has own automatic mechanical cross-over.

Total Flux—415: 240,000; 615: 308,000
Frequency Range .... 20-35,000 c/s.
Fundamental Resonance .... 25 c/s.
Maximum Power Handling:
415 .... 20 watts; 615 .... 25 watts
Impedance .... 16 ohms

Price:
415 .... £52/15/-; 615 .... £76/10/-.

Bass that beats all bass with the

AUDIOM 60 (12")



Not just the "lows," but the lowest register of the musical scale is encompassed and ensured by placing of fundamental resonance.

This high-fidelity loudspeaker is a robust single-cone unit built on a rigid cast chassis. Design features in the coil and magnet system provide linearity of drive of high amplitudes whilst still maintaining high electro-magnetic damping.

Fundamental Resonance .... 35 c/s.
Max. Power Handling Capacity: 15 watts
Flux Density .... 14,000 gauss
Total Flux .... 158,000 maxwells
Impedance .... 15 ohms

Price: £25/17/6.

BRITISH MERCHANDISING PTY. LTD.
60 CLARENCE STREET, SYDNEY
Please send a copy of GOODMANS "High-Fidelity Loudspeaker Manual" to:

NAME ....

ADDRESS ....

....

12

BRITISH

HIGH-FIDELITY SPEAKERS

Advances beyond all standards ever before achieved with this type of unit.

AXIOM 300 (12")

The Axiom 300 — incorporating new developments — not only gives a performance with negligible distortion, but provides the smoothest, most extended response ever achieved in a twin-cone, high-fidelity loudspeaker. Standing waves and spurious resonances are prevented by exacting terminations of both diaphragms.

Frequency Range .... 30 c/s.-16,000 c/s.
Max. Power Handling Capacity: 15 watts
Flux Density .... 14,000 gauss
Impedance .... 15 ohms
Total Flux Density ...... 158,000 maxwells

Price: £29/2/6.

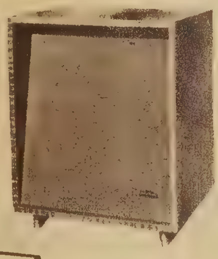
For treble response plus—

TREBAX 35 XL

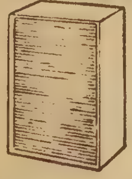
This new Trebax pressure-driven, horn-loaded, high-frequency unit now has its own 12 db octave, 5,000 c s. crossover network.
On the back of the unit are screw-type connectors for "INPUT" and "BASS" facilitating connection to loudspeakers carrying your bass and mid-frequency registers.
For high-frequency control, 16-ohm variable L-pad on a 36" cable is provided.

Price: £17/15/-.

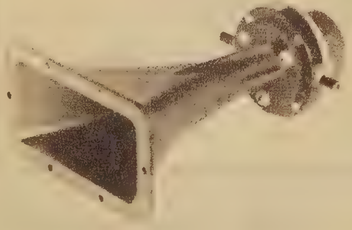
CABINETS FOR 1-2-3 SPEAKER SYSTEMS



The SHERWOOD II is designed for single or multiple-speaker systems, incorporating the appropriate Acoustical Resistance Unit.
To blend with any furnishing, these cabinets are available complete in polished walnut or pine; alternately plans are available for those wishing to make their own.



For stereo—cabinets saving space
The Axiette cabinet, ideal for stereo reproduction—specially designed to carry the Axiette II speaker. Plans available.
Sound systems need crossover networks. The GOODMANS XO-950 and 950 x 5,000 (to suit MIDAX 950) are designed to give that full frequency flawless coverage.
Also available are ARU's for all purposes.
Further information on request.



MIDAX 950—completely free from distortion with high efficiency. The Midax 950 unit is the correct choice when the major advantages of a horn-loaded middle register loudspeaker are required. Making allowance for the overlap regions, crossover frequencies are 950 c/s. and 5 Kc/s.

Frequency Range .... 650 c/s.-8,000 c s.
Crossover Frequencies .... 950 c/s. and 5,000 c/s.
System Power Handling Capacity .... 25 watts
Impedance .... 15 ohms

Price: £21/18/6.

Prices quoted are retail and fixed in all State capitals.

MERCHANDISING PTY. LTD.

60 CLARENCE STREET, SYDNEY. BX 1571

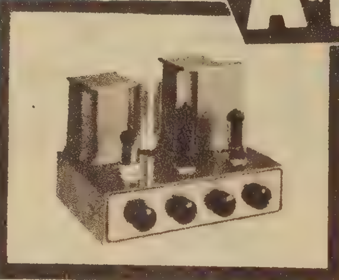
A B.M.P. COMPANY

ELECTRONIC
A&R
EQUIPMENT

Building a MULLARD Amplifier?

Make the job EASIER with an . . .

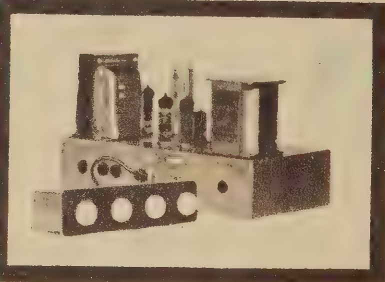
A&R CHASSIS AND TRANSFORMER KIT



MULLARD 3/3 AMPLIFIER

A most popular kit — one that makes building the Mullard 3/3 so much easier — giving the final job a true, professional finish. Assembly, layout wiring details, together with performance and specifications are clearly outlined in the Mullard 3/3 leaflet, obtainable from your local distributor.

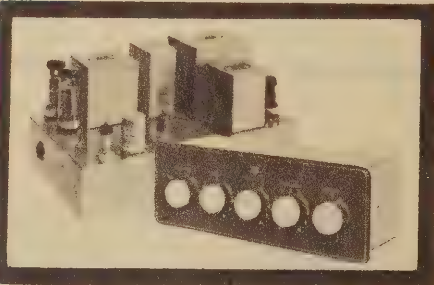
A PROFESSIONAL JOB IN BOTH FINISH AND PERFORMANCE!



MULLARD 5/10 AMPLIFIER

Another favourite with home constructors made so much easier to build with the A. and R. Foundation Kit. The Main Amplifier Chassis follows closely the layout shown in the Mullard Booklet, "High Quality Sound Reproduction." Pre-amp unit is redesigned — both units allowing the use of locally obtainable components.

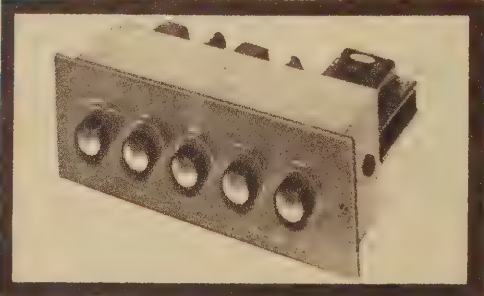
INDIVIDUAL UNITS OF ANY KIT MAY BE PURCHASED SEPARATELY



MULLARD 20 WATT AMPLIFIER

For the Constructor aspiring to the Mullard 20 Watt, the A. and R. Foundation Kit is invaluable.
The Pre-Amplifier and Main Amplifier Units closely conform to the layout shown in the Mullard Booklet, and both allow the use of locally obtainable components. Construction is so much simpler with the A. and R. Kit—and the finish is one of which you can be justly proud!

FULL DETAILS OF A & R KITS AND MULLARD CIRCUIT LEAFLETS AVAILABLE



MULLARD "2 STEREO 2"

A. and R. engineered throughout, the Two-Stereo-Two includes all hardware necessary to produce a high quality Stereo unit of professional appearance. The attractively enamelled front panel is finished in Beige, with Cream numerals, and as with all A. and R. Foundation Kits—all parts are available separately if desired!

CHECK WITH YOUR NEAREST A & R DISTRIBUTOR

WATCH FOR THE 5 STEREO 7 RELEASED SHORTLY

ELECTRONIC
A&R
EQUIPMENT

DISTRIBUTORS

VIC.: J. H. Magrath and Co. P/L., Radio Parts P/L., Homecrafts P/L., Motor Spares Ltd., Warburton Franki Ltd., Howard Electrical and Radio Co., Douglas Radio Co. **SOUTH AUST.:** Gerard and Goodman, 196 Rundle St., Adelaide. **QLD.:** A. E. Harrold P/L., 123 Charlotte St., Brisbane, Chandler's P/L., Albert and Charlotte Sts., Brisbane, Trackson Bros. P/L., 157 Elizabeth St., Brisbane. **WESTERN AUST.:** A. J. Wyle P/L., 1064 Hay St., Perth. **TAS.:** Homecrafts P/L., 220 Elizabeth St., Hobart. **N.S.W.:** Factory Reps.: R. H. Cunningham P/L., 16 Angas St., Meadowbank. Available from all Leading Sydney Distributors.

A. & R. ELECTRONIC EQUIPMENT CO. PTY. LTD. *378 St. Kilda Road, Melbourne, S.C.1. MX 1150.*

NEWS AND VIEWS OF THE MONTH

Scaring birds by electricity

A REPORT from England says that the problem of keeping away the ordes of pigeons which have disfigured uildings in London has finally been olved.

For years methods involving superonic noises, entanglements, and irritants ave been tried all over the world, inluding Australia.

Now a method described as the transission of harmless pulses through mall copper conductors once every secnd has had a trial on St. Paul's Cathedal with gratifying results. From this escription it appears as though the rinciple used is similar to that of the lectric fence, which has been so sucessful in keeping horses and cattle withn bounds.

On the west portico of St. Paul's, ammers and chisels have hitherto been sed to remove deposits up to one foot n thickness. Architects are now conidering whether they will instal the sysem to other parts of the building.

The city of Birmingham has also been lagued by the activities of its picturesque inhabitants and, in Sydney, passrs-by have often had unhappy experinces from the same source.

Now Trafalgar Square, traditional ome of London's pigeons, and Nelson's olumn, regularly a sufferer from such ndignities, may eventually be freed from uch visitations when electronics gets to vork. Other buildings must doubtless ollow suit in self defence.

* * *

Tennis is fast

IT is hardly surprising that spectators at international tennis championships find it hard to keep their eyes on he ball. A speed of as much as 200 m.p.h. has been recorded for a tennis ball in play.

An ordinary good shot travels at between 70 and 80 miles an hour, according to Robert Symes in a BBC talk.

"This means that it takes only one-fifth of a second for the ball to travel from the racquet of the server to the other side of the net.

"To hit a ball travelling at 100 miles an hour, you have to apply a force of 57 pounds to the head of the racquet, and the energy required is over 10 horse power. At 150 miles an hour, the force required is 87 pounds."

Dr Otto Edholm, of the Division of Human Physiology at Britain's Medical Research Council, added that, in addition to power, a very high order of skill was required to hit a ball travelling at these high speeds so that it went over the net and into the part of the court where the player wanted it.

A mistake in timing of the order of one-thousandth of a second would have considerable effects.

* * *

Aid for dumb

A DEVICE that will help the dumb to speak has been developed by a British dental surgeon, Mr R. V. Tait. The appliance is designed to provide a voice for people who have had the larynx, or voice-box, removed by surgery.

The majority of such patients were able to speak again by what was called an oesophageal voice — that is, by modulating into speech the air returning up the oesophagus, or tube, running from the mouth to the stomach; but a few people could not speak at all after such operations.

Mr Tait stated that the device he had developed was a small box, about the size of a pocket wallet, with a few controls attached.

For people who have false teeth, the most important components are normally made as an upper denture and, for those with their own teeth, they are made to fit into the roof of the mouth and supported by the surrounding teeth. Inside the palate of this dental plate there is a diaphragm which can be set in vibration electrically.

When a switch on a small box, usually carried in the pocket, is pressed, the diaphragm vibrates and produces a sound which can be used as a voice.

* * *

New blowlamp

A NEW British-made blowlamp, the Vatlock, No. 3, that needs no pumping, was described by Allan Murray in a recent B.B.C. broadcast.

"It's automatic, and there's nothing either erratic or unsafe about the way it works," Murray said. "It's precision-built from solid brass and it burns not paraffin, but methylated spirit, which is not only less dangerous but also cleaner to work with.

There's no smoke or smell and it doesn't leave the deposit on metal that you get with a paraffin flame. In fact, it's an exceptionally efficient tool — reliable, clean, simple to use, and foolproof.

It is just the job for the amateur decorator or handyman, although it's a thoroughly professional instrument, with a flame temperature of about 2,000 degrees Fahrenheit—hot enough to melt the hardest silver solder on the market."

The blowlamp is started up by putting spirit in the pint-sized fuel tank, then filling the priming cup on top and putting a match to it. The cup holds enough spirit to burn out in a few minutes, and by then the lamp has started to blow, and keeps on blowing until the operator loosens the filler cap in the neck by a couple of turns.

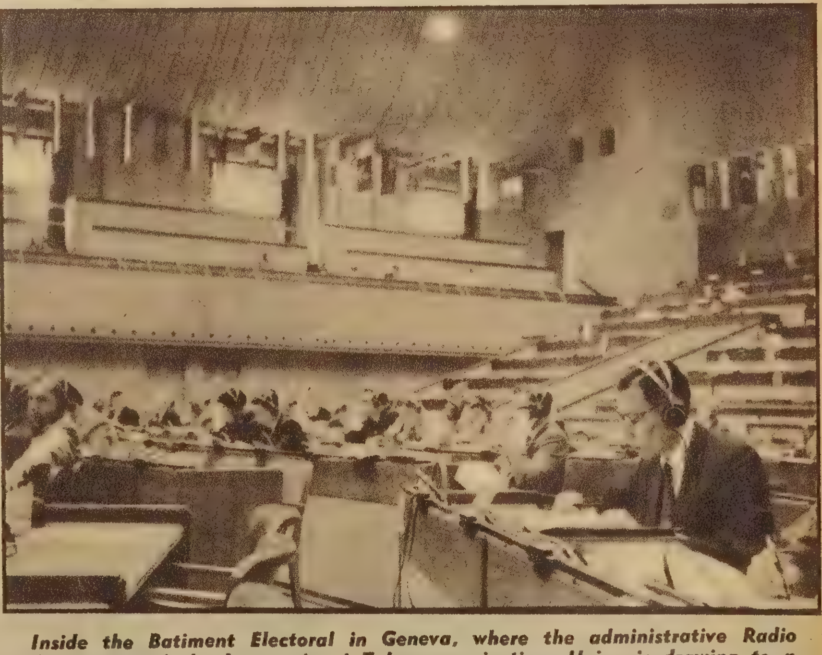
A sleeve around the burner tube has vents that can be opened when working indoors or closed to a draught, and that is the only adjustment necessary until the lamp is put out. A thin bar across the inside of the burner tube, made of special steel that never burns out, ensures that if the flame goes out accidentally it will pick up again without priming, so long as the bar remains hot.

* * *

Fairey rotodyne

A CONTRACT for the further development of the Fairey Rotodyne vertical take-off airliner is to be placed by the British Ministry of Supply. Negotia-

ITU CONFERENCE DRAWS TO CLOSE



Inside the Batiment Electoral in Geneva, where the administrative Radio Conference of the International Telecommunications Union is drawing to a close as this issue goes to press. John Moyle, Editor of "Radio, Television and Hobbies," and W.I.A. delegate-observer at the conference, is due back in Sydney this month.

Here NOW!

ROLATAPE

"The Tape with the Famous Name"

ROLA
Longer Recording..
ROLATAPE
50% more recording time per reel
"lovely to listen to"
HIGH FIDELITY
MAGNETIC RECORDING TAPE
ROLA
ROLA COMPANY AUST. PTY LTD

Rola magnetic recording tape is the product of Research and Development carried out with the thoroughness which has made the Rola name synonymous with the world's finest loudspeakers.

Rolatape comes in two grades — 1½ mil PVC base General Purpose tape which meets the requirements of most professional, educational, or home recordists and a Premium Quality 1 mil tape using a super-strong Polyester base which provides 50% longer recording time.

Rolatape is spooled on 5 and 7 inch reels carrying 600 and 1,200 feet respectively for the PVC base tape, or 900 and 1,800 feet respectively for the Polyester base tape.

These are the internationally recognised standards to which Rolatape is made:

- ***Frequency response beyond 15,000 c.p.s., at a speed of 7½ inches per second.***
- ***Background noise more than 65 db below recording level.***
- ***Modulation noise more than 50 db below recording level.***
- ***Distortion less than 2%.***
- ***Variation in output less than 1 db over any spool and less than 2 db between spools.***

Rola magnetic tape — **"THE TAPE WITH THE FAMOUS NAME"** — will bring new depth and realism to all your recordings.

ROLATAPE DISTRIBUTORS:

VICTORIA	**W. & G. DISTRIBUTING CO. PTY. LTD.** 185 A'Beckett Street, Melbourne - - - - - - - FJ 3651
N.S.W.	**THE LAWRENCE & HANSON ELECTRICAL CO. PTY. LTD.** 862 Elizabeth Street, Zetland. And Branches. - - MX 4041
QUEENSLAND	**THE LAWRENCE & HANSON ELECTRICAL CO. (Q'LAND) LTD.** 85-87 Elizabeth Street, Brisbane. And branches. - - - - 21151
SOUTH AUSTRALIA	**A. G. HEALING LTD.** 376 King William Street, Adelaide - - - - - - W 0171

ROLA COMPANY (AUST.) PTY. LTD.

tions are also going on for the purchase of a military version of the aircraft.

Besides these developments, British European Airways is to start direct negotiations with the Fairey Aviation Co. to buy six Rotodynes.

A Fairey spokesman said development of the Rotodyne was now assured. The first of these airliners with two 5,250 h.p. Rolls-Royce Tyne propeller turbine engines would fly in the winter of 1961 and deliveries of production aircraft would start at the beginning of 1964.

A prototype with two 2,800 h.p. Napier Eland propeller turbines has been flying since November, 1957. It can carry 48 passengers. The Tyne engine version is much larger and faster.

The Rotodyne has a rotor for take-off and landing vertically, like a helicopter. For forward flight power to the rotor is cut off and it flies as a conventional fixed-wing airliner powered by the propeller turbine engines.

The Fairey spokesman said B.E.A. had discussed a possible requirement of 20 Rotodynes. New York Airways had said they intended to order five, with an option of 15 more, and Okanagan Helicopters, of Vancouver, had ordered one.

The Rotodyne was the first vertical take-off airliner in the world. Cruising at 200 m.p.h., with 70 passengers, it was nearly twice as fast as any contemporary Western helicopter and had three times the capacity and almost eight times the productivity in regular airliner operations.

* * *

Satellite relays

THE U.S. Defence Department has announced plans to hurl communications satellites into high polar orbits to relay messages between ground bases and military aircraft.

The satellite communications system apparently will be designed chiefly for use by the Strategic Air Command's globe-girdling hydrogen bombers.

The plan was disclosed in a brief announcement that development contracts would be awarded to General Electric Co. and Bendix Aviation Corp.

General Electric will develop the satellite vehicle system at a cost of 5,500,000 dollars. Bendix will develop the communications subsystem, or "talking" part of the satellite, at a cost of 8,500,000 dollars.

The project carries the name "Notus," a Greek word meaning "the south wind."

* * *

Rocket escape

ESCAPE equipment was successfully tested recently for the U.S. satellite capsule that will carry man into space.

The test was made in a rocket shoot at Wallops Island, Virginia.

Engineers of the National Aeronautics and Space Administration (NASA) launched the capsule to an altitude of 38,000ft with a powerful "Little Joe" booster.

The test was said to have been a complete success.

The capsule is similar to that in which a Mercury astronaut will be fired into orbit some time in 1961.

It descended into the Atlantic five miles from NASA's Wallops test station on the eastern shore of Virginia.

The pilot escape system consists of a tower-like rocket on top of the capsule. If anything goes wrong at launching time the escape rocket can be triggered to lift the capsule free of the booster.

STEREOPHONIC EQUIPMENT

We would like to thank all our friends and customers (and those who are both) for the confidence they have shown in us and wish all a happy Christmas.

It is a suitable time for us to announce our new units and policy regarding trade ins. We keep all the best makes of equipment as listed below.

We know the finest equipment combinations can cost £1000.

For those who must watch their pockets as well as use their ears our new lines will offer value and sound hitherto unknown.

The amplifiers used are our version of the Mullard 5-7 employing A & R gain oriented transformers in a normal or high gain variation.

Using the Acos diamond stereo and TX-88 mono cartridges, TPA— 12 arm, Collaro transcription motor complete with amplifier cabinet. 2 Wharfedale 8/145's in Columns the total cost would be **under** £145.

Using a Decca FFSS the cost would be **under** £190. Prices include finishing. All components can be obtained separately.

For those wishing to convert to stereo we offer many services. We have new mono equipment that is being sold at incredible prices. Just right for a 2nd channel.

We trade in mono on stereo at more than generous rates. The trade-ins are sold at a low figure to keep the equipment moving.

You are welcome to listen to the equipment at your convenience day or evening by making an appointment at JB2820.

TERMS ARE AVAILABLE ON ALL ARTICLES

RETAIL AND TRADE SUPPLIERS

SPEAKERS
Quad Electrostatic
Goodmans
Wharfedale
Vitavox

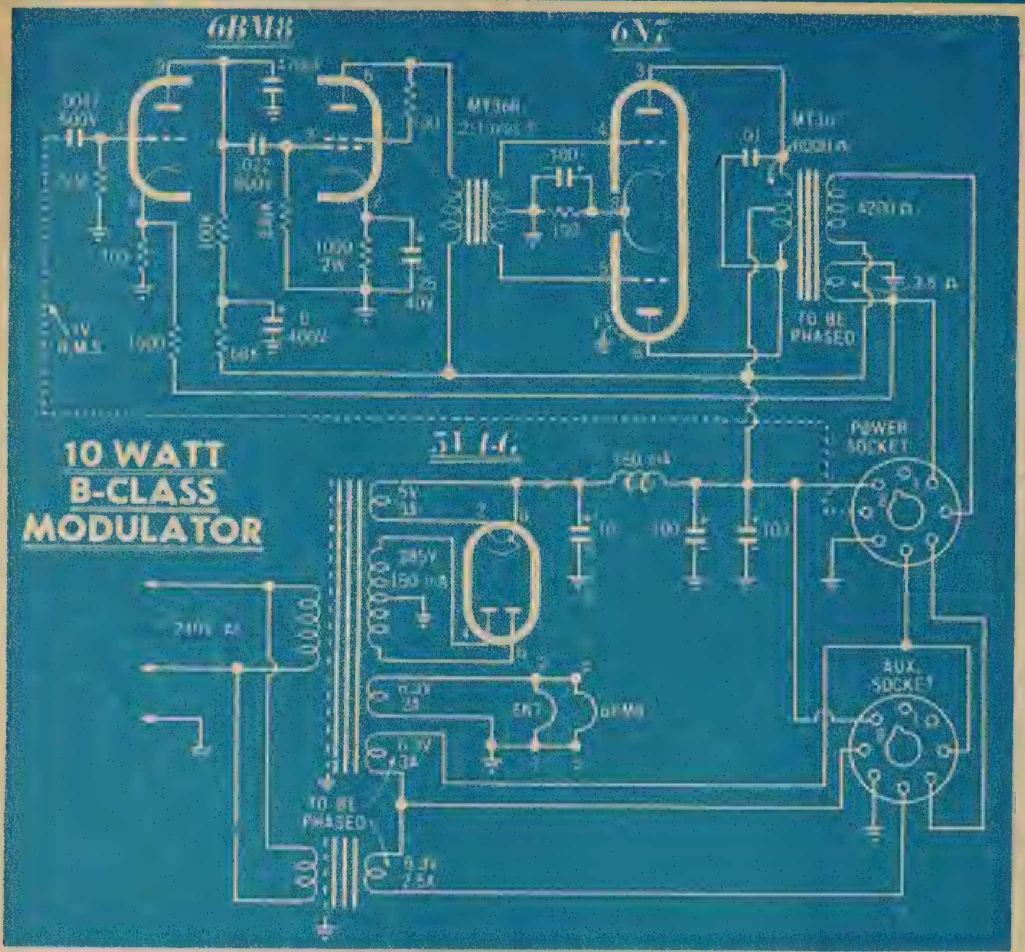
PICKUPS
Decca
Elac
Ortophon
Acos

AMPLIFIERS
Quad
Leak
Parameter
Audiomaster

MOTORS
Orpheus
Garrard
Collaro
Neat etc.

ENCEL ELECTRONICS

Enquiries—354 BRIDGE RD., RICHMOND, VIC. JB2820
361 BRIDGE ROAD—Showrooms.



The circuit is of a basic 10 watt modulator capable of excellent quality by amateur standards. For maximum effectiveness it may be used with the speech preamplifier, clipper and filter circuit on page 35.

Major components are seen in the top view of the modulator and power supply. The power transformer is large enough to supply the RF sections of the transmitter as well as the 6N7.

Underneath view. The driver transformer is at the top right, filament transformer to the left and filter choke below. Large value filter capacitors are used to keep the voltage steady with the varying current.

A 10-Watt B-Class Modulator

Numerous 10-watt class-B modulators using valve type 6N7 or its derivatives have been described in overseas publications since the valve was first introduced some time ago. Reasons for the popularity of the circuit are that the valve is compact, rugged and economical of current.

by Maurice Findlay

UNFORTUNATELY, in this country, it has not always been possible to buy suitable transformers for a 6N7 class-B modulator. Resistance-capacity coupling is not practical and therefore, despite the advantages of the 6N7 modulator for the 10 watt power level, it has not been used very widely.

Arrangements have now been made with at least one manufacturer to have the components released through the normal trade channels so that there should no longer be any difficulty on this score.

The driver transformer type number MT368 has a ratio of 2 to 1-plus-1 and is suitable for matching a wide range of driver valves to the 6N7 grids.

The output transformer (type MT367) is designed to reflect 8,000 ohms plate-to-plate to the 6N7 from a secondary load of 4,200 ohms. A third winding matches the 6N7 to 3.5 ohms when the main secondary is not loaded.

It is used for feedback and also to drive a speaker, should it be desired to use the modulator as the audio section of a receiver in a transceiver arrangement. The wire is fairly fine and therefore the power transfer efficiency to voice coil impedance will not be high. However, since there is power to spare for most purposes, this is not important.

Correct loading for the 6N7 is provided when the total current loading of the modulated RF amplifier valve is about 70 mA at the normal 300 volts. This gives a DC power input to the plate of a screen grid power amplifier valve of close to 20 watts.

Although you can't expect to compete with 150 watt stations on the same frequency, this power will enable you to maintain Australia-wide communication on the normal high frequency bands under most conditions, with opportunities for overseas contacts under good conditions.

Should you care to try your hand at "dexterity modulation" on 14 Mc, there should be no difficulty making plenty of overseas contacts with 20 watts.

Current interest in the subject arises from the author's plan to build up, for personal use, a small portable transmitter-receiver to operate on 3.5, 7 and 14 Mc.

It may be possible to describe the receiver and transmitter section in a later issue but in the meantime it was felt that the modulator itself would be of interest.

MODULATOR AND POWER SUPPLY

The physical layout of the modulator was chosen to fit in with the requirements of the remainder of the system and it is most unlikely that anybody would want to build it in the original physical form. For this reason, we have not included large and detailed photographs.

Most amateurs like to lay equipment out to suit their own particular installation and even the circuitry is usually regarded as a collection of ideas to be used and modified according to the special requirements of the builder. After all, experimentation in order to gain familiarity with equipment is one of the most important reasons for the existence of the amateur radio movement.

Interest in the present circuit centres around the output stage and the discussion of the details could well start at this point.

Manufacturers of the 6N7 recommend a plate supply voltage of 300. The valve may then be operated at zero bias, when the standing plate current for both units will be about 35 mA.

10w POWER OUTPUT

Given a plate-to-plate load of 8,000 ohms and suitable drive, the 6N7 is capable of developing 10 watts of audio power at less than 10 per cent distortion. The average plate current will then be about 70 mA.

Our own experience has shown that it is possible to apply some standing bias to the 6N7 in order to reduce the current drain. If the standing current drain, particularly, can be reduced then the heating of power supply components will also be reduced. It may mean that it is practical to use a smaller power supply.

Standard practice in battery-operated mobile equipments is to pick up the bias voltage from the DC supply system. If the positive side of the supply is grounded, the driver transformer centre tap is connected to 6 volts negative or if the negative side of the battery is grounded the cathode is connected to 6 volts positive. For a 12 volt system, a divider can supply the necessary potential.

Often the valve filaments serve this purpose.

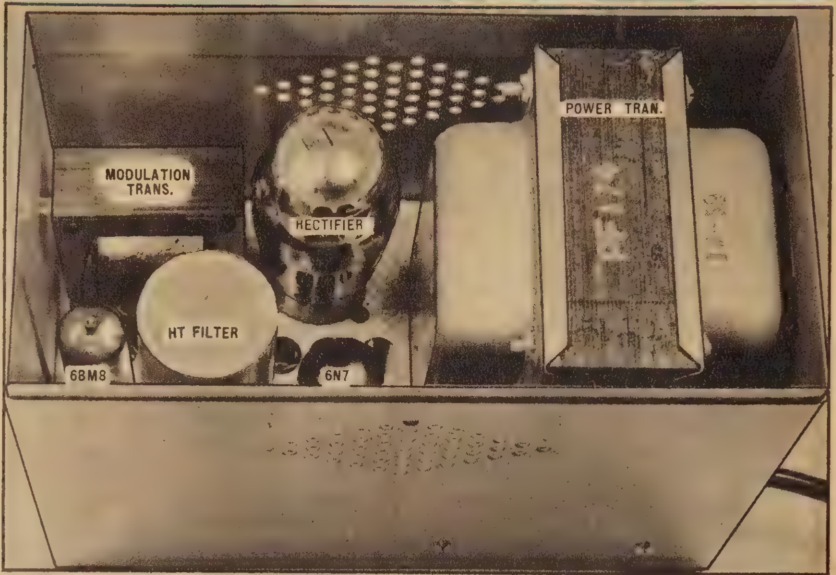
Six volts is only a small proportion of the total 300 volts and its subtraction from the total supply is usually unimportant.

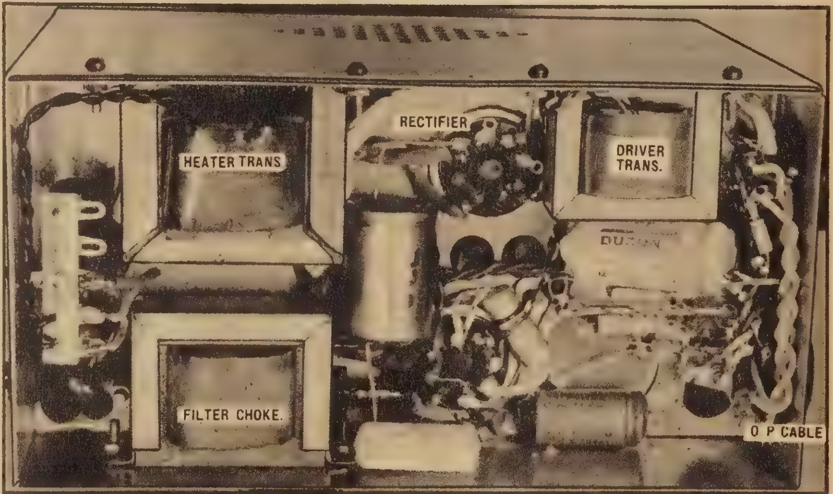
In the case of an AC-operated equipment, no convenient low-resistance bias source is available. It is not possible to obtain a precise 6-volt bias from a cathode resistor because what starts out as 6-volt bias at low signal levels may become 12 volts at high signal levels and result in crossover distortion.

CATHODE BIAS

Standing current drain can be reduced to a worthwhile degree by applying a small amount of cathode bias, adjusting the value so that crossover distortion just begins when maximum signal is applied for a long period. In this case, a 100-ohm resistor appeared to be the best compromise. It is by-passed by a 100 uF capacitor in order to reduce the degeneration.

Leakage inductance between the two halves of the modulation transformer primary is to be expected in a relatively inexpensive transformer. This becomes more important at higher frequencies. Since we are not interested in frequencies above about 5 Kc for a modulator, it is legitimate to overcome many of the deficiencies of the transformer by placing a fairly heavy bypass, in this case .01 uF, from plate to plate.





This capacitor also serves to reduce the high frequency components due to crossover distortion as may occur with particular valves operated at high signal levels continuously.

Feedback cannot be relied upon for this purpose because the gain of the valve is low at the crossover point and the feedback loop incomplete.

By the way, the high-mu double triode 12AX7 can be used in place of the 6N7 in this same circuit. It will not deliver quite the same power—the plate dissipation is not as high as the 6N7 and it is not advisable to operate it at full output for long periods. However, it has the advantage of being physically small which may be worthwhile in very compact equipments.

For a normal class A amplifier, the impedance looking into the grid circuit is high throughout the entire cycle. With the class B 6N7, however, the grids are driven into the positive region and draw current. The impedance of the circuit varies throughout the cycle and unless the drive source has a low impedance, heavy distortion can result.

In this modulator the power pentode section of a 6BM8 is connected as a triode and its output fed to the grids of the 6N7 via a step-down transformer. As valves go, the 6BM8 power section as a triode has a low plate resistance which is further reduced by the transformer action as far as the 6N7 grids are concerned.

Screen and plate of the 6BM8 pentode are joined by a resistor to prevent possible parasitic oscillation.

A 6V6 connected as a triode also makes a good low impedance driver for the 6N7.

BIAS RESISTOR

Bias voltage is obtained by the use of the usual cathode bias resistor, while an electrolytic capacitor prevents degeneration.

The 6BM8 triode section is of the high-mu type and bias can most conveniently be obtained by placing a large resistor in the grid-cathode circuit. The system works perfectly and an electrolytic capacitor is saved. There is a 100-

GENERAL ACCESSORIES
PTY. LTD.

100 Clarence Street, Sydney
Phone BX4451

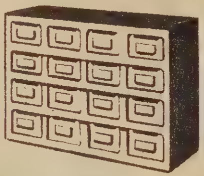
YORK ST
BARRACK ST
KING ST
CLARENCE ST

HANDY CABINETS

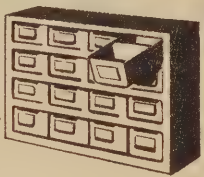
A craftsman built unit attractively painted in pearly grey baked enamel with provision for fittng identification card on each drawer. A strong and most useful cabinet for holding small parts or tools, ideal for mechanic, engineer, garage, store-keeper or home workshop. Provision is made for stacking and all units will interstack.

Available in the following Models Packed in a Strong Carton.

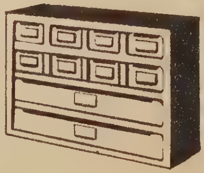
MODEL A
52/-
Cabinet 12" x 9" x 5½". 16 drawers 5½" x 2⅝" x 1½".



MODEL H
55/-
As Model A—but fitted with Divisions.



MODEL D
52/-
Cabinet 12" x 9" x 5½" 8 drawers 5½" x 2⅝" x 1½". 2 drawers 11" x 5½" x 1½".



Bib Wire Strippers
6/3 ea.

Neon Test Screwdrivers
10/6 ea.

CRYSTAL SET BUILDERS

Single Gang Condensers,	1 guinea
Q plus Headphones	£2/1/
Spring Terminals	1/2 ea.
Germanium Diodes	
OA70—OA73	6/1 ea.
OA81—OA85	7/1 ea.
Jabel Crystal Coil	8/6 ea.
Aerial Wire (100ft)	14/9 ea.
Insulators	1/ ea.
Boys' Book of Crystal sets	5/ ea.
Single Crystal Earpiece, complete with lead and plug	18/6

MANUALS

Radio Servicing No. 1	7/6
Radio Servicing No. 2	8/9
Radio Servicing No. 3	7/6
Fault Finding	7/6
Magnetic Recording Wire and Tape	7/6
Transistor and Crystal Diodes	7/6
The Oscilloscope Book	8/
Television Servicing No. 1	8/
Television Servicing No. 2	8/
Television Servicing No. 3	8/
Television Servicing No. 4	11/-

PHILIPS VALVE DATA BOOK
NEW ISSUE
18/6, plus 2/1 postage.

SCOPE

SOLDERING IRONS 6 sec.

Standard	£2/10/-
Instrument	£2/10/-
Vibroscope	£1/15/-
Transformers	£2/10/6

GLEN RADIO AC/DC INVERTERS

50 watt inverters:
12, 24, 50, 32, 110, 230v DC input 230v 50 cycles AC output—
£22/9/6

100 watt inverters:
12, 24, 32, 50, 110, 230v DC input 230v 50 cycles. AC output—
£33/2/6

150 watt inverters:
12, 24, 32, 50, 110, 230v DC input 230v 50 cycles, AC output—
£37/1/3

RECORD CHANGER AND PLAYER SPECIALS

Collaro 4 speed player	£8 0 0
Collaro 4 speed Conquest Changer	10 15 0
Collaro 4 speed 6 volt Battery Operated Player	13 2 6
Collaro 4 speed Stereo Player	12 12 6
Collaro 4 speed Stereo Changer	17 10 0
Collaro 4 speed Transcription Units less pickup	20 0 0
Collaro 4 speed Transcription Units with Arm	26 15 0

ALL BRAND NEW IN UNOPENED CARTONS
Fully Guaranteed
BE EARLY

Screw-type hole cutters

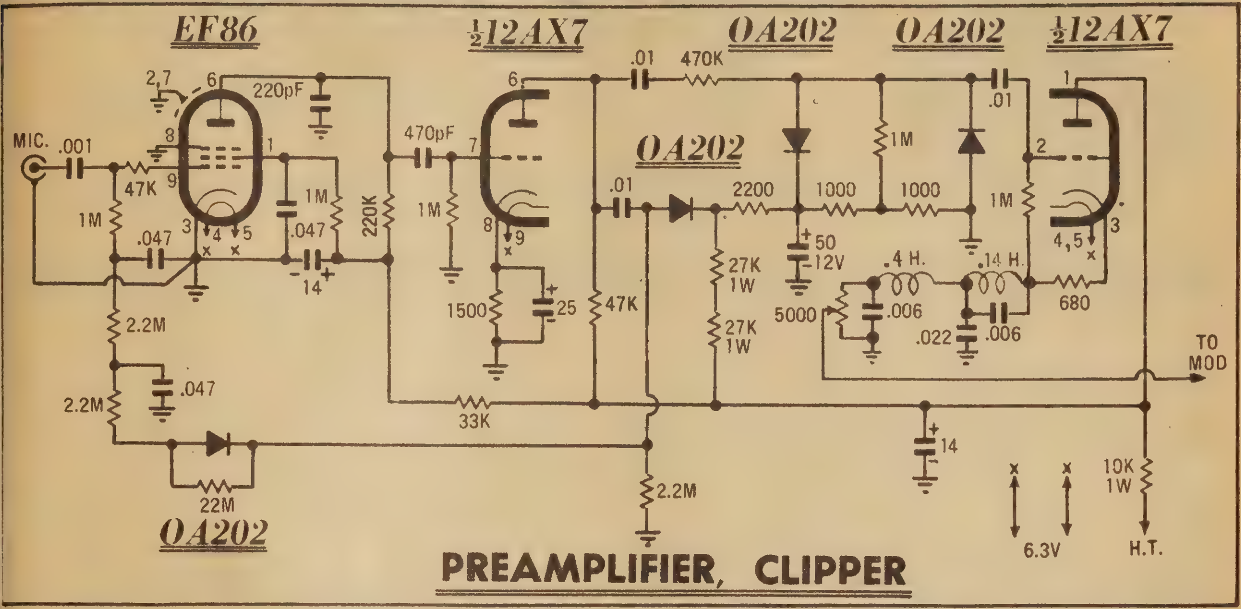
⅞" 7 pin	£1/9/-
¾" 9 pin	£1/15/-
1⅛" Octal	£2/18/-

CRYSTAL SETS: Q-Plus set only	£2/13/6
Q-Plus, complete with aerial, headphones, etc	£4/19/6
Q-Plus Transistor model, complete with aerial, headphones, etc.	£6/19/6

GOLDRING Crystal Lapel Microphones
30/ ea.

General Accessories Pty. Ltd., 100 Clarence Street, Sydney. Phone BX4451 and 30 Buckland Street, Chippendale. Phone MX4701

SPEECH AMPLIFIER PROVIDES AGC, CLIPPING


EF86
½12AX7
OA202
OA202
½12AX7
OA202
OA202
MIC.
.001
47K
1M
2,7
6
8
9
3
4
5
1
220pF
1M
.047
14
220K
470pF
7
1M
6
8
9
1500
25
.01
470K
.01
2200
1000
1000
1M
.01
1M
2
1
3
4,5
50
12V
.4 H.
.14 H.
.006
.022
.006
5000
680
27K 1W
27K 1W
47K
.047
2.2M
2.2M
.047
33K
14
22M
2.2M
10K 1W
6.3V
H.T.
TO MOD
PREAMPLIFIER, CLIPPER

Although there is a large number of individual components in the speech amplifier, it can be built in a small space. By keeping the average level of speech nearly constant, it increases the effective output of the transmitter several times without overmodulation.

ohm resistor in the cathode. This is included as a convenient circuit across which to develop the negative feedback voltage.

Although not great by high fidelity amplifier standards, the 6 to 8db feedback which results from the circuit constants given helps to keep the distortion low and extend the frequency range.

With feedback, distortion is low by communication receiver standards. Frequency response is smooth and within 3db between 60 and 6,000 cps. which, as discussed later, is more than adequate for modulator use.

For full output about 1 volt rms is required at the grid of the 6BM8 triode.

A carbon microphone with transformer could easily drive the modulator to full output and where the simplest possible system is required and for, say, a mobile application this may be a proposition. On the other hand, the quality standards which are regarded as acceptable on the amateur bands are on the increase and, in order to meet them, a crystal or dynamic microphone is required.

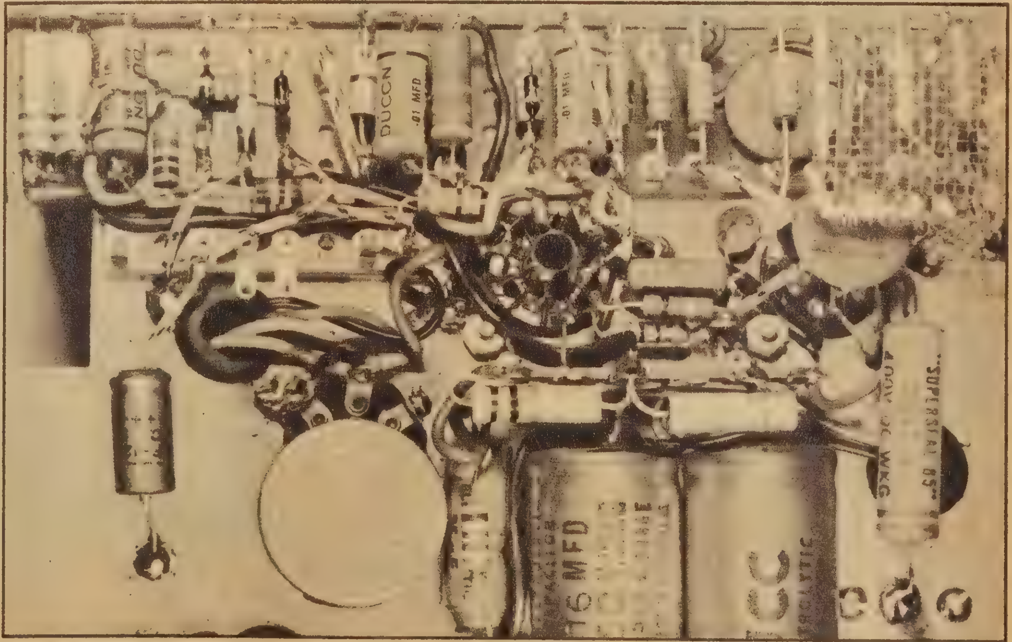
Close speaking conditions plus a diaphragm-type crystal microphone will result in an output around 0.1 volts maximum. The output of a dynamic (moving coil) or ribbon microphone is considerably less. Therefore, for one of the better quality microphones a preamplifier stage is required.

Overall gains of up to 200 can easily be obtained with low-noise pentodes such as the EF86 in a simple resistance capacity circuit. Full output is then available on .005 volts rms input, at maximum gain, bringing the modulator up to the gain requirements of most microphones amateurs are likely to use.

A schematic circuit with suitable marked values is published here. A potentiometer in the plate circuit of the valve controls the gain, permitting the simple bias system for the 6BM8 triode section to be retained. This is not regarded as good practice in amplifier design but can be justified here on the grounds that the control is not often rotated.

The output of the EF86 has a relatively high source impedance, even when a high output crystal microphone is being

☆

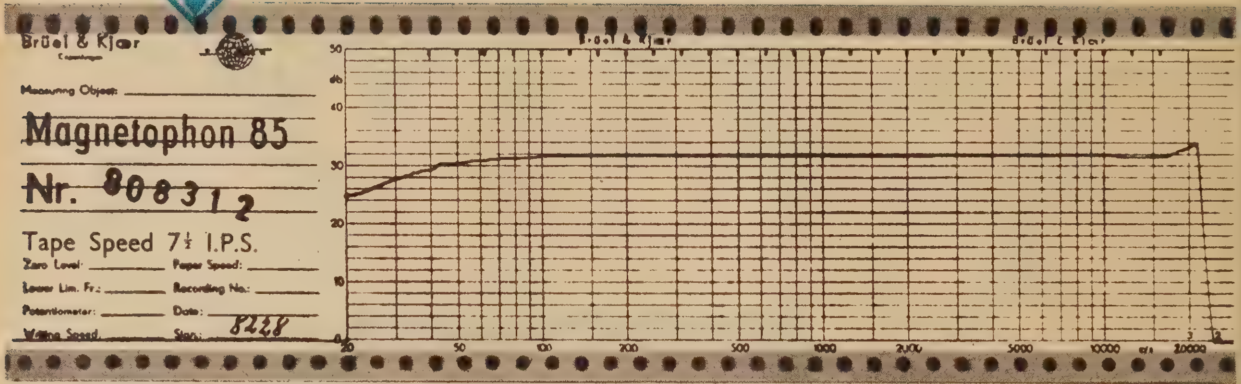

DUCON
.01 MFD
16 MFD
SUPERSTAT 85°

Modern miniature resistors and capacitors enable the entire preamplifier to be assembled quickly, possibly in a vacant corner of an existing modulator. Actual length of the resistor panel at the top is 6 inches.

NEVER BEFORE-

A HIGH-FIDELITY TAPE RECORDER

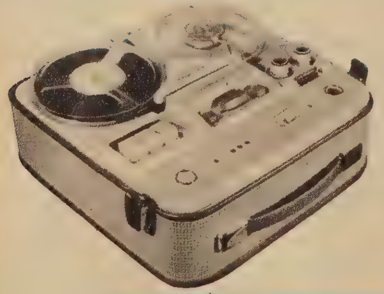
with guaranteed Frequency Response Certificate



The quality of every tape recorder depends largely on its frequency response. Up to now, it has been the usual practice to state only the upper and lower limits of frequency response. Generally, no indication was given of the falling off in dB at these limits or of the fluctuations in response of frequencies in between these extremes • Since every TELEFUNKEN Magnetophon 85 is thoroughly tested from the playback head to the amplifier output, before leaving the factory, the guaranteed response from 30-20,000 c.p.s. at 7½ i.p.s. is ensured within ±3 dB. The result of this test—a Frequency Response Certificate—is included in each portable model. This is an impressive proof of quality, exceeding all that is implied by "Hi-Fi" standards.

MAGNETOPHON 85K Portable... £195/15/0
Tape speeds 7½ and 3¾ i.p.s. Frequency Range 30—20,000 c.p.s. at 7½ i.p.s. 30—15,000 c.p.s. at 3¾ i.p.s. Spool size 7 in. Playing time for 2400 ft. Double Play Tape 2 x 2 hours 6 minutes at 3¾ i.p.s. Signal to noise ratio ≧ 50 dB. Automatic stop at end of tape. Two 7 in. x 4 in. loudspeakers with 3 watts output.

MAGNETOPHON 85K Stereo ... £210/0/0
Technical specification as for Model 85K with additional facilities for playing stereo tapes.



MAGNETOPHON 75K—15 £159/9/6
Tape speeds 3¾ and 1⅞ i.p.s. Frequency Range 60—16,000 c.p.s. at 3¾ i.p.s., 60—9000 c.p.s. at 1⅞ i.p.s. Spool size 5¾ in. Playing time for 1800 ft. Double Play Tape 2 x 3 hours 10 minutes. Output 2.5 watts. Weight 21 lb.

Available from :—

New South Wales : Messrs. Edels Pty. Limited, 88 King St., Sydney. Messrs. J. Stanley Johnston Pty. Ltd., 437-9 George Street, Sydney. Magnetic Sound Industries (Aust.), 387 George St., Sydney. The Hi-Fi Audio Centre, 25 Wentworth Street, Parramatta. Other enquiries to: W. C. Wedderspoon Pty. Ltd., 193 Clarence Street, Sydney.

Victoria : Maxwell's Radio Pty. Ltd., 269 Lonsdale St., Melbourne. Melbourne Tape Recorders, 355 Elizabeth St., Melbourne.

Queensland : Messrs. Chandlers Pty. Limited, Brisbane and Branches.

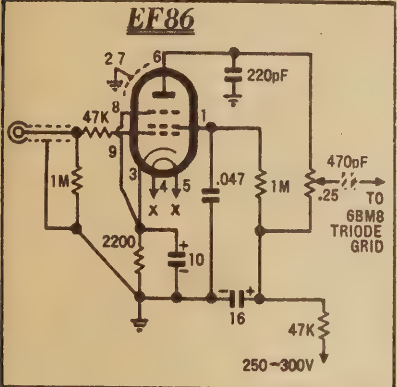
South Australia : Messrs. Newton McLaren Ltd., 17-23 Leigh Street, Adelaide.

Accessories : The above prices include a dynamic microphone, one spool of tape, empty spool and radio connection lead. A full range of accessories also available.

used and the gain control is set near minimum. Therefore it is not permissible to feed the audio through the power socket as shown in the main circuit. Rather, a separate length of shielded lead should be used.

Overall maximum gain of the system can be adjusted over a limited range by adjusting the amount of feedback. Smaller amounts of feedback will have a correspondingly less favourable effect on distortion, while there is a danger of oscillation if the feedback is greatly increased.

By suitably "processing" speech the effectiveness of the modulation of a transmitter can be greatly increased without overmodulation. This subject was discussed in the December, 1957, issue, where a speech preamplifier and clipper was described. The present circuit is an adaptation of the original, with silicon diodes substituted for the 6H6's in order to save heater power and space.



This simple preamplifier circuit works well and provides sufficient gain to enable a crystal or low output dynamic microphone to be used with 10 watt modulator. The output lead should not go through common cable to the 6BM8 triode grid but rather through a separate shielded cable.

Briefly, an EF86 is used as a microphone preamplifier followed by a 12AX7 as a voltage amplifier. Part of the audio at the plate of the 12AX7 is rectified and filtered, to be applied to the grid of the EF86 as an automatic gain control voltage. Therefore the output of the 12AX7 tends to remain constant, with varying levels of speech and different microphones.

Low audio frequencies contribute little to the intelligence of telephony transmissions and these are attenuated by using a small value coupling capacitor between the EF86 and the 12AX7. Low frequency attenuation is sought only in the one coupling circuit, with the object of causing a smooth 6 db per octave roll-off rather than the sharp roll-off which would result if a number of stages were given the same time constant.

In this case, a 470 pF capacitor and a 1.0 meg resistor give a satisfactory result for most voices, but you could reduce the lower frequencies even further by reducing the value of the coupling capacitor to as low as 220 pF. You could also reduce the grid return resistor to 0.47 megohm. This would also result in a loss in gain at the higher frequen-

(Continued on Page 125)

CHOOSE THE BEST—IT COSTS NO MORE

O.T.L.
RESIN CORED SOLDER WIRE
Neff. Tin
SWG 16
ELECTRICAL EQUIPMENT
GUARANTEED CORROSION FREE
LEMPRIERE & CO. LIMITED

Resin Core
SOLDERS
for reliable connections

O. T. LEMPRIERE & CO. LIMITED
Head Office: 27-41 Bowden Street, Alexandria, N.S.W.
and at Melbourne • Brisbane • Adelaide • Perth

Edels
for
PHILIPS
tape recorders

"PROFESSIONAL FIDELITY"
Model ER1500 A
HIGH FIDELITY
SINGLE-SPEED
LIGHTWEIGHT
RECORDER
EL3515 A

Both new Philips models give you convenience and perfect performance

- EXCLUSIVE RECORDING PLAY-BACK HEAD
- EXCLUSIVE MODULATION INDICATOR
- EASY MAINTENANCE
- FULL MIXING FACILITIES
- BUILT-IN PROGRAMME INDICATOR
- "PIANO KEY" PUSHBUTTONS
- MONITORING FACILITY
- SAFETY-LOCK BUTTON

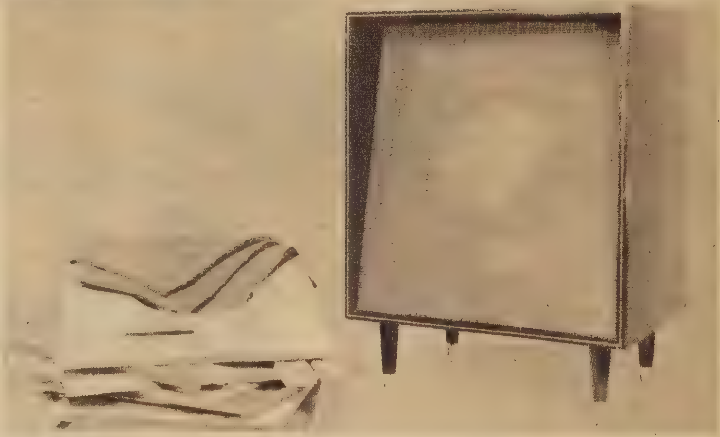
TRADE-INS ACCEPTED! EASY TERMS AVAILABLE!

Edels PTY. LTD.

88 KING STREET
BL 1551

ARROW ELECTRONICS PTY. LTD.

CABINETS CABINET KITS



We now have available a range of complete cabinets and cabinet kits.

"SHERWOOD" Cabinets: Solid plywood, all veneered, cut to accommodate 12in speakers, with optional treble and middle speakers. Finished cabinet, polished in maple, walnut or rosewood, with legs and plastic grille cloth: **£25/19/6.**

Sherwood Kit: Precision cut, complete with all screws, nails, felt, gold trim, etc., ready to be assembled less legs, **£14/8/.**

'G' Speaker and Control Cabinets: Matching speaker and control cabinets for 2 or 3 unit systems. Speaker cabinets are cut for most 12in speakers, have provision for optional tweeter, attenuator and A.R. unit. Fully felt lined, these are covered at front with plastic grille cloth.

Control cabinets feature player recess to suit most record players, have lift up lid, and will accommodate almost all amplifier or radiogram chassis.

These cabinets are handsomely finished in matched maple, walnut or rosewood veneer, with or without matching trim and may be purchased separately or in matched sets. **PRICE: per cabinet: 19gns.**

8" and 12" Bookshelf Speaker Cabinets: These cabinets have compact dimensions, may be mounted horizontally or vertically, are made from veneered plywood and are ready sanded for polishing, and come complete with felt lining and fixing screws.

Model AK8: 23in x 11in x 10in, suits most 8in speakers	**£9/7/6**
Model AK12: 24in x 21in x 10in, suits most 12in speakers	**£12/13/**

OR you may purchase these cabinets in ready-cut kit form, complete in every detail, at these amazing prices: 8in, **£6/14/6**; 12in, **£8/16/.**

LOUDSPEAKERS:

The Quad Electrostatic speaker presents a new listening experience — freedom from all resonances, and exceptionally low levels of distortion. **£159/10/.**

Wharfedale: We carry a full range of Wharfedale speakers from 3in tweeters to 15in bass units, including the new compact W-2, W-3 and W-4 speaker systems. Further details available on request.

Goodmans: Axiom 300: **£29/1/9**
Axiom 400: **£43/19/**
Axiette 2: **£16**
Trebax: **£12/5/3**
Midax: **£21/18/3**
Triaxiom 615: **£76/10/**
Triaxiom 415: **£52/15/**

We also have available a range of Rola speakers—why not discuss your requirements with us?

Turntables and Record Players:

Thorens:	TD134L	**£35/10/**
	TD184L	**£43/10/**
	TD124L	**£70**
	TD124	**£61/10/**

Orpheus: Two models, 4 speed, with speed variation, belt drive turntables. Standard model **£29/17/6.** Silex, **£37/14/8.**

Connoisseur: 3-speed transcription, **£50/14/9.**

Garrard: Transcription turntable, **£46/2/6.**
Hi Fi Stereo player, model 4HF, complete with stereo pickup, **£30/6/6.**

"Everything from Stylii to Speaker Cloth"

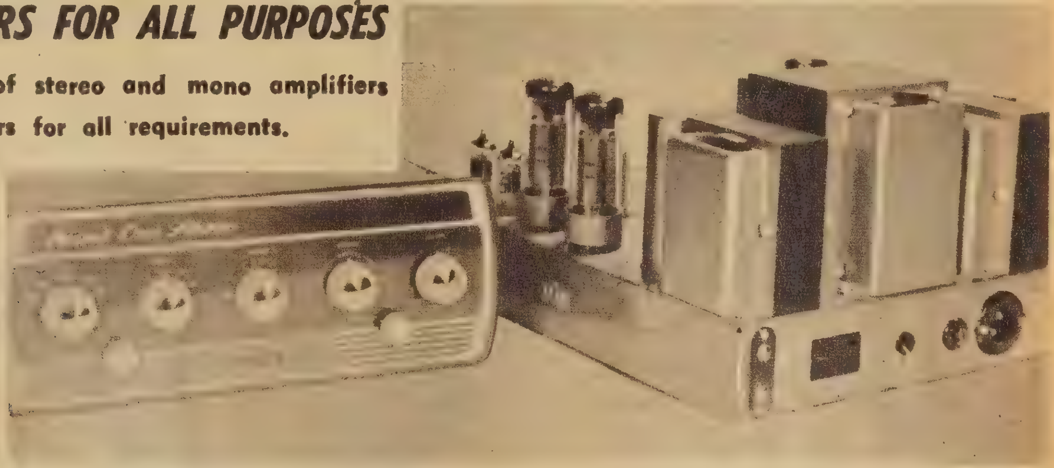
ARROW ELECTRONICS PTY. LTD.

422 KENT STREET, SYDNEY BX6731

ARROW ELECTRONICS PTY. LTD.

AMPLIFIERS FOR ALL PURPOSES

Our range of stereo and mono amplifiers caters for all requirements.



LEAK: Stereo 20 twin 10 watt amplifier with stereo control unit £147

Stereo 50: Illustrated as above, 25 watts per channel, with preamp £180

'Point One' Stereo Preamplifier: Provides full stereo-mono control facilities, can be used with 2 mono amplifiers .. £60

ACOUSTICAL: The new Quad 22 stereo control, designed for use with Quad 11 power amplifiers. This is a unit of remarkable flexibility, and provides for almost all possible requirements of stereo operation, **£64/15/.** Quad power amplifiers, **£61.**

GRAMPIAN: Quality with economy — a slogan which describes this range of equipment. For mono operation now and stereo later, choose Grampian 590/1 stereo control unit with one power amplifier. To convert to stereo, simply fit one amplifier type 584 in the space provided. Alternatively, purchase the unit as a complete stereo model. 590/2. 590/1, **£58/5/**; 584, **£27/19/**; 590/2, **£91.**

ROGERS: Junior amplifier (10-12 watt push-pull), **£41/5/**

Cadet amplifier (5 watt push-pull) **£29/12/6**

Junior stereo control unit (for use with cadet or Junior amplifiers) **£48**

ASTRONIC: Model A1444, table top or cabinet mounting, a complete stereo amplifier with separate bass and treble controls, inputs for crystal pickup, tape or tuner, **£59/18/**

> **ATTENTION!** The omission of certain items from these lists is not intended to indicate that we do not have these in stock. Our range of equipment covers all requirements, and we are able to supply everything from individual components to complete music systems. We also carry a range of tape recorders, microphones, recording tape and accessories.

"ORTOFON for pickup supremacy." The Ortofon range of pickups covers all requirements and prices.

16in arm RM309, **£46/1/9.** Stereo head, diamond stylus, **£34/5/.**

16in arm RF309, **£38/9/10.** "C" diamond mono head, **£31/11/.**

16in arm RK309, **£28/9/10.** "A" diamond mono head, **£16/18/2.**

12in arm SK212, **£10/17/9.** A sapphire mono head, **£6/2/.**

12in arm S212, **£6/11/.** Transformers, various impedances, **£5/7/.**

NOW AVAILABLE The SSM212 precision arm with G shell, which will accommodate ½in mounting cartridges, **£20/12/3.** (This unit may be supplied with "Ortofon" cartridges.)

DECCA FFSS Stereo Pickup: A precision product of the renowned Decca organisation, complete with diamond stylus, **£42.**

G.E. CARTRIDGES: These famous mono and stereo cartridges are now available.

Mono VR11 (sapphire)	Stereo VR227 (diamond)
Mono VR11 (diamond)	Stereo VR225 (diamond)

"Everything from Stylii to Speaker Cloth"

ARROW ELECTRONICS PTY. LTD.

422 KENT STREET, SYDNEY BX6731

PHILIPS STEREO

Record Changers and Record Players

TYPE NG1020

Triple-Function STEREO Record Changer

Now produced specifically for stereo operation, the popular Philips push-button record changer fulfils the exacting demands of this exciting new development in record reproduction.

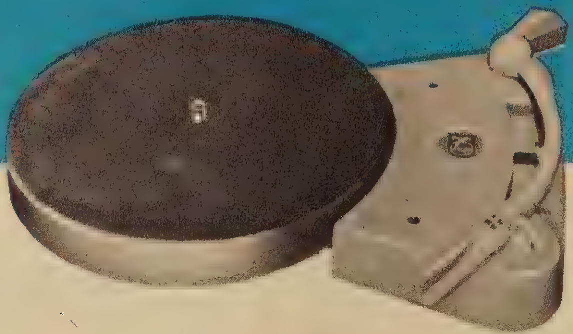
- Two separate plug-in high-fidelity pick-up heads: L.P. and Stereo type AG 3063; 78 r.p.m. type AG 3066.
- Plays all types and sizes of records—Stereo, L.P., 78, 45, 33⅓, 16⅔.
- Push-buttons for easy operation.
- Smooth, silent, wow and flutter free, absolute minimum rumble.

Three separate functions.

1. Fully automatic changer—loads up to ten records.
2. Automatic single play. Single records may be placed directly on the turntable.
3. Manual single play.

21 GNS.

PHILIPS



TYPE NG1009

A.C. Player with Stereo Counterweight and Stereo Pick-up Head

A pick-up arm counterweight is now available as an accessory for the popular Philips four-speed record player. With the stereo pick-up head plugged in, the counterweight reduces the needle pressure to the correct amount for playing stereo recordings. This removes the need to use inaccurate spring devices and the unit provides a compact stereo player for the widest applications.

NG1009—A.C. player with standard twin stylus pick-up head	**£10-9-0**
AG3063—Stereo pick-up head	**£2-7-6**
NG1023—Stereo counterweight	**10-6**
Mounting plate	**15-6**
NG1012—6-volt battery-operated version of record player	**£13-5-0**

P1651.59

PHILIPS ELECTRICAL INDUSTRIES PTY. LTD.
Sydney • Melbourne • Brisbane • Adelaide • Perth • Hobart

FROM THE SERVICEMAN WHO TELLS

Remember how, about three years ago, most of us were having a mild attack of the horrors at the thought of having to service TV sets? Well, with that one behind us, most servicemen are now facing up to another newcomer; transistor sets. While in no sense as big a problem as TV, there are plenty of important things to learn about this phase of the art.

THUS, for the second time in a few years, the serviceman has had something fundamentally new and different thrust upon him and has had to acquire new knowledge and new experience in order to cope with it.

I often wonder whether the average user of electronic devices has the slightest concept of the amount of training or experience represented in a reasonably competent serviceman, or how much work is involved in keeping pace with the ever-increasing rate of progress.

Happily enough, TV seems to have arrived and settled in without causing too many mental breakdowns, and most of us, looking back, probably wonder what we worried quite so hard about. Nevertheless, this was not achieved without a lot of work and a fair amount of study by all concerned.

(Looking forward, I can think of plenty to worry about. I wonder how long it will be before we are faced with the ultra miniature, all transistor, colour TV set? Ouch!)

However, since TV can fairly be called a major hurdle, it would seem that we should be able to take transistor sets in our stride. After all, they are still only radio sets, with the same internal functions as we have always known. It's just that the job is performed in a different way.

"SAME—ONLY DIFFERENT"

For this reason most fellows seem to be adopting a "same-only-different" attitude on the basis that fault-finding techniques that have been well established for valve circuits are equally suitable for transistors.

In many respects, this is true. It still is basically sound to first locate the faulty stage, whether by signal injection, signal tracing, or even simple observation in some cases, according to whichever is appropriate. Then the most likely components can be checked either by measurement or substitution, until the fault is located.

However, while such broad basic principles remain sound there are many differences in detail which are very important. Failure to recognise them can lead to false diagnosis and waste of time or, worse still, damage to transistors and other components. It is these details I wish to discuss now.

To be perfectly honest, the amount of transistor servicing I have had to do so far has been strictly limited and, from what my colleagues tell me, this has been the case with most small independent organisations until recently.

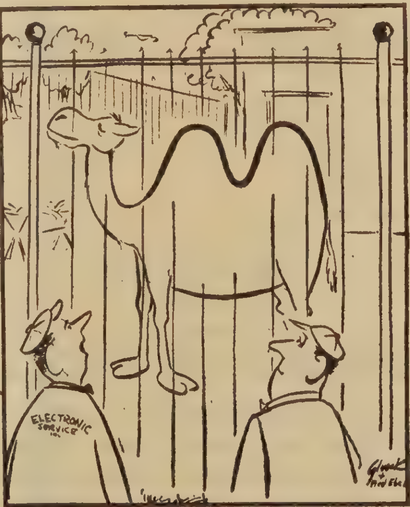
The explanation is not hard to find. Transistor sets have only been produced by local manufacturers, in any quantity, over the last 12 months or so and not a great many of them have had a chance to give trouble. Of those that have, a goodly proportion seem to have been relatively simple faults, while most of the "too hard" ones probably found their way back to the makers under guarantee.

As far as the imported types are concerned the situation is different again. These have been handled by a relatively few large organisations who, very wisely, realised that the success of any such venture depended largely on their ability to provide adequate service facilities. This they appear to have done and I know of no serious problems that have arisen in this regard.

LIMITED NUMBER

However, it does mean that individual servicemen are not likely to see many of these sets for the present at least. They naturally return to the organisation from which they were bought.

Thus, to date, my main activities have been to replace batteries, select and fit substitute batteries in those cases where the original imported types were not available locally, and clean up the battery contacts in a couple of versions of one model which seems particularly prone to corrosion from salt air.



"That reminds me, I've got an FM alignment on the bench."
("Radio-Electronics").

Another case involved a set brought in by an overseas traveller which suffered an open circuit speaker voice coil. Diagnosis presented no problem, but finding a suitable replacement did. There was nothing available locally which would even look like fitting the space and it was clear that a correct replacement would have to be obtained.

Fortunately, the owner had a friend going overseas and he was able to obtain one without becoming involved in too much red tape. Then it was simply a matter of fitting and connecting it. Incidentally, I understand that this is a fairly common weakness in some models; a problem which the makers will doubtless overcome with a little more experience.

NOTHING GOES WRONG!

Fairly obviously, none of the above have taxed my resources to any worthwhile degree and one might be pardoned for being lulled into a false sense of security on the basis that ". . . nothing much ever goes wrong with transistor sets"—to quote one or two fellows with whom I have discussed this lately.

But don't be deceived. Apart from the transistors, these sets use conventional components just as in any other set and my bet is that they will develop most of the component faults with which we already are familiar. To be sure, the voltages involved are lower and this undoubtedly will help to some degree, while the fact that most conventional sets suffer mainly from valve failures must mean a higher order of all-round reliability.

However, this does not mean that you or I cannot find ourselves faced with a "curly one" in a transistor set, just as in a valve set. And when we do, something more than a knowledge of how to change batteries or replace a speaker is going to be needed if the job is to be done efficiently.

For this reason, I offer the same advice as I did when TV was peeping over the horizon: Get as good a grasp of the fundamental principles — theory if you like—as you possibly can as a first step. It is only one rung of the ladder, I know, but it's a mighty important one.

PRELIMINARY STUDY

This is just what I have been doing myself over the past few months, together with some practical work in the form of simple set building when time permits. While fully aware that there is still much to learn, particularly on the bench, I am also aware that the time spent is beginning to pay off in terms of useful general knowledge and an ability to think of transistor circuits as such; that is, without having to translate them through valve configurations first.

This latter point, incidentally, is a most important one. Valve analogies are all right up to a point; they provide a useful stepping-stone to bridge the gap between the known and the unknown, but we must appreciate that the analogy breaks down very quickly when it comes to details. So, the sooner we can learn to think directly in terms

KITSET SPECIALS

BUILD IT YOURSELF . . .

. . . FOR HALF PRICE

1. Reinartz (Batt) 2
2. 32v Radiogram 7
3. Batt. S/W Converter 1
4. Batt. S/W Converter 2
5. Batt. All Wave Converter 2
6. Reinartz (A.C.) 1
7. S/W 3 Band 3
8. S/W (A.C.) Converter 1
9. S/W (A.C.) Converter 2
10. All Wave (A.C.) Converter 2
11. Hybrid Car Radio
12. Transigram
13. Interstate (A.C.) 5
14. Miniature (A.C.) 5
15. Dual Wave (A.C.) 5
16. Dual Wave (A.C.) 6
17. Globespan (A.C.) 8
18. Portagram (A.C.) 4
19. Transistor 1
20. Transistor 2
21. Transistor 3
22. Transistor 4
23. "Transporta" 6
24. "Transporta" 7
25. 13 Watt P.A. Amp.
26. 25 Watt P.A. Amp.
27. 35 Watt P.A. Amp.
28. Transistor 10w Amp.
29. Hi-Fi 3 Amp.
30. Hi-Fi 5 Amp.
31. Mullard 3-3 Amp.
32. Mullard 5-10 Amp.
33. Mullard 2-2 Stereo
34. Mullard 5-7 Stereo
35. Twin 5 Stereo Amp.
36. Twin 10 Stero Amp.
37. Twin 17 Stereo Amp.
38. 5" Wide Range C.R.O.
39. 21" TV (R.TV & H.)
40. V.T.V.M.
41. R/C Bridge
42. 50 Mc/s Converter
43. 144 Mc/s Converter
44. M/M 1000 ohms/volt
45. M/M 20,000 ohms/volt
46. Signal Tracer
47. Playmaster Tuner
48. High Gain Preamp

Listing a few of OUR POPULAR "1959" Complete KITSETS

"TRANSPORTA 7" £26/9/-

PLAYMASTER TUNER £12/7/6

MULLARD 2-2 STEREO £21/15/-

HYBRID CAR RADIO £26/10/-

"TWIN 10" STEREO £36/10/-

V.T.V.M. £20/15/-

TRANSISTOR 10W AMP £26/10/-

"GLOBESPAN 8" £27/15/-

HI-FI 3 AMP £13/7/6

MULLARD 5-7 STEREO £30/15/-

13W P.A. AMP £14/5/-

Call or write for LITERATURE AND PRICES on any of the above kits.

We stock ALL RADIO and TV COMPONENT PARTS, including — VALVES, CONDENSERS, RESISTORS, RECORD PLAYERS & CHANGERS, TRANSCRIPTION UNITS, TAPE DECKS, SPEAKERS, CARTRIDGES, STYLI, MICROPHONES, DIODES, RECTIFIERS, METERS, TRANSISTORS, POWER & OUTPUT TRANSFORMERS—ETC.

DON'T BUY Before You Get OUR Quote

MAIL ORDERS TO ALL AUSTRALIAN STATES AND THE PACIFIC AREA

ELECTRONIC DEVELOPMENTS

NICHOLAS BUILDINGS,
37 SWANSTON STREET, MELBOURNE

Phone 63-5973 Phone 63-5973

f transistors and transistor terminology, he better.

Apart from straight-out text books, here is a good deal of literature availble from local manufacturers. These ontain a lot of information of an essenially practical nature and would seem o be just as essential to the serviceman s their equivalent in valve data handooks. As well as the current types long with their essential electrical data, here are preliminary discussions on heory, typical circuits, and lists of quivalents by other manufacturers.

Some of the theoretical discussions re quite comprehensive and cover much f the ground that will be found in nore expensive text books. While not uggesting that these will replace a good ext book, they do provide a useful ddition to it. In addition, there are ists of references which will prove very useful in helping to select a text book o suit one's own particular needs.

SEVERAL SYSTEMS

The typical circuits help to relate the heory to practice and to assist in quick recognition of circuits, and parts of hem, when encountered in practice.

The lists of equivalents are likely to prove almost essential in the future. At he present time there are four major ocal organisations handling transistors, most being locally made and a few being imported. Between them there are three type marking systems, and this can be very confusing unless one has some means of relating equivalent and near equivalent types.

It is perhaps unfortunate that transistors seem to have got off to this kind of a start, just when we seemed to be getting the valve type numbering system pretty well tidied up.

However, it may take some time for things to settle down like this in the transistor field, due to the large amount of research and development being carried on independently by several manufacturers. We may well have to wait until manufacturing techniques are better understood and more completely standardised.

To make matters worse, most imported sets use type numbers completely foreign to the local market, making necessary yet another list of equivalent types. Some of these have been identified by local manufacturers, but the list is by no means complete.

APPLICATION DATA

Four local manufacturers have published data sheets and other information on this subject. From Philips Electrical Industries there is one entitled, Germanum and Silicon Transistors and Diodes (price 12/6); from Amalgamated Wireess Valve Co., AWV Transistors, Cataogue No. T-5 (price 7/6); from Mullard, A Simple Explanation of Semiconductor Devices (price 4/-), plus abridged data sheets (stamped addressed envelope), while similar data by Standard Telephones and Cables is included in the S.T.C. Valve Data Handbooks.

In addition, there are two other A.W.V. publications which I would recommend. These are: Servicing Transisorised Radios (price 2/-), and Transistor Fundamentals and Applications (price 5/-). The first is an excellent discussion on servicing techniques and the econd an equally good introduction to ransistor theory.

TIED UP WITH THE EHT SUPPLY

This story has a happy—even humorous ending, but it quite easily could have been just the opposite. So, while enjoying the joke, don't overlook the warning it is intended to convey.

It concerns a technical liaison officer employed by one of our large TV manufacturers; a technician whose job it is to visit any dealer who is faced with an unusually sticky problem and help him over the difficulty. It was while engaged in one of these jobs that the incident occurred.

The set had a separate picture tube mounting and the dealer had removed the chassis, set it up on the bench, and connected it to the picture tube in the cabinet by means of a coupling cord. The set-up looked innocent enough, and our friend was quite unsuspecting as he leaned over the chassis to check it.

The next moment he experienced a quite frightening contraction of the throat muscles, as if some ghostly hands were trying to throttle him. That was bad enough, but it was followed almost immediately by a stunning "rabbit killer" across the back of the neck

Completely bewildered, he staggered back from the bench and inquired weakly what was going on; in particular he wanted to know why the dealer (standing behind him) was dealing out "rabbit killers" without good reason. And when that worthy gentleman denied all knowledge of any such assault—with obvious sincerity — it only served to deepen the mystery.

But not for long. It was quickly realised that our friend had received a violent shock, but the puzzling point was how, and why it had affected him the way it had. As far as he could recall he had touched nothing likely to create such a situation.

It was a small burn mark on the lower end of his necktie which provided the clue, and a "reconstruction" of his position (with the power off!) showed that this had brushed against a bare connector in the EHT line of the connector cord.

This would have been harmless enough in the ordinary way, but the tie happened to be one of the currently fashionable types which has a thin aluminium thread woven through it as a decorative feature. This had touched the EHT lead, perspiration in the collar providing the final conducting path to the throat muscles.

As far as can be determined, connection must have been initially at the side and front of the neck then, as the head was moved slightly, directly at the back of the neck near the spine. This latter would account for the "rabbit killer."

Fortunately, apart from a bad shaking, our friend was little the worse for the experience. However, nasty and all though 16 KV of EHT may be, he is fully aware of the much more dangerous possibility of making contact with the 240 volt mains. So much so, in fact, that he went home that night and promptly destroyed all the metal thread ties he possessed.

And, to make doubly sure, he has vowed never to wear anything other than a bow tie from now on!

I'm not sure whether he really is serious about this latter point, and I feel that it may be taking precautions a little far, but it is perfectly obvious that conventional ties with a metal thread are a potential death trap to anyone engaged in the radio or electrical game.

And ties are not the only items involved. Metal thread fabric is becoming increasingly popular and quite a number of shirts — and possibly other garments—are being made from it. They could be equally dangerous in similar situations.

So, regardless of your sartorial taste when off duty, it would seem wise to choose the more conventional — if conservative — style of dress during working hours.

(Note: The October issue of Radiotronics just to hand contains a very comprehensive equivalent chart.)

Turning to the problems of actual servicing, there has been a good deal written on this subject in various journals and all I intend to do is pick out those points which appealed to me as being among the least obvious but most important. I am assuming that the reader is already well versed in conventional servicing.

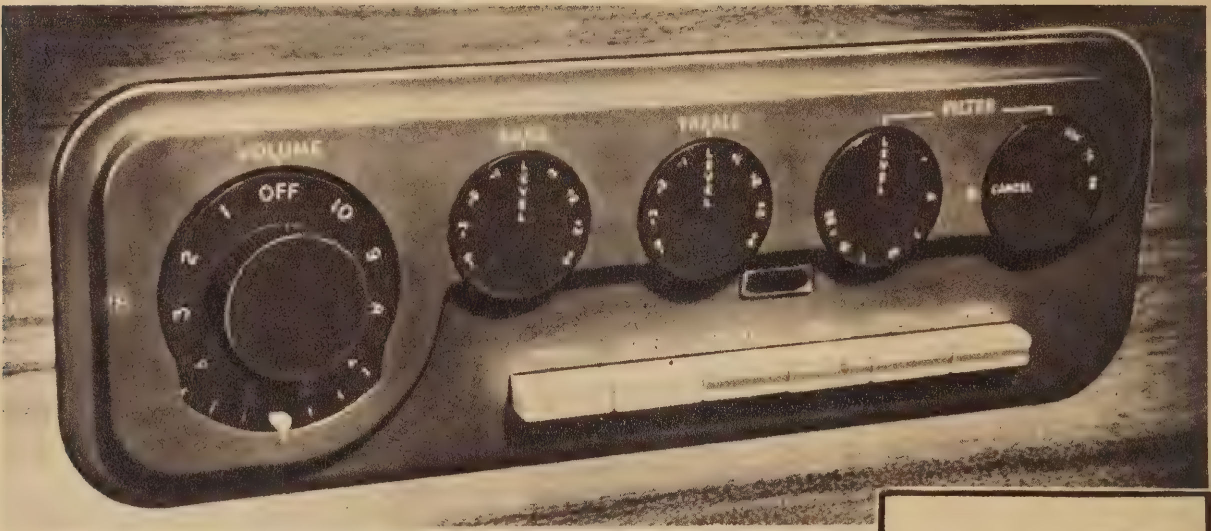
(It must be emphasised that much of what I have to say is merely what already has been written elsewhere and that I make no claim to it as original work. However, the wisdom of most of it will be obvious as soon as it is mentioned.)

Undoubtedly the most important single point concerning transistor servicing is the need to protect the transistor from damage. Throughout all the discussions on this subject the prominent theme has been this hazard and the precautions necessary to avoid it.

Once the serviceman can accept this idea, plus the fact that there are many unsuspected ways in which it can happen, he has taken a major step towards successful transistor servicing.

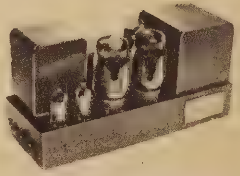
This may seem like a condemnation of transistors. It is not, really, but we

Control Panel of
World's Finest
Stereo amplifier



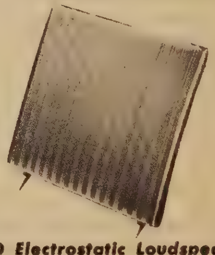
QUAD 22

Incorporating the newest design refinements and greater flexibility of input, the Quad 22 is designed for monophonic and stereophonic reproduction. Quad 22, the world's finest Control Unit, has separate volume and balance (for stereo) controls, bass and treble controls, filter slope and filter switch.
Quad 22 operates from radio and microphone, disc and tape, single track and stereo. Matching is provided for any pick-up.
Select input by depressing one or a combination of the four right-hand buttons, choose any of four play-back characteristics from gramophone, then listen to "the closest approach to the original sound." And remember, this magnificent achievement is from a unit similar in size to the Quad II Control Unit. Price: £64/15/-.



QUAD II Amplifier

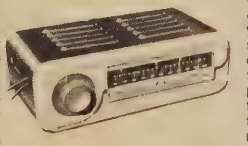
Use one Quad II amplifier with your Quad 22 Control Unit for monaural, or two for the finest stereo.
The finest amplifier in the world, the Quad II produces 15 watts of undistorted power throughout the range 20-20,000 c/s. Price: £61/5/-.



QUAD Electrostatic Loudspeaker

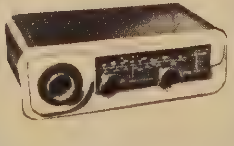
Completely distortionless reproduction in rooms from 1,000 to 5,000 cubic feet. This is not "spectacular hi-fi" — it's designed for completely natural, non-fatiguing "pure fidelity," so important to serious music lovers of all types. 70° optimum listening area. 45 c/s.-18 Kc/s. Price: £159/10/-.

F.M. Tuner



Operates in conjunction with Quad 22 Control Unit and amplifier through your hi-fi speaker system. Tuner indicator shows a tuning error of one part in 10,000. Extremely low distortion and high-noise rejection. Price: £61/-/-.

A.M. Tuner



Also operates through Quad amplifier and hi-fi speaker system. Response is incredible when the quality of its source is considered. Modulation frequencies up to 12 Kc./s. are accepted: Long and medium wave bands. Price: £61/-/-.

Prices quoted are retail and fixed in all State capitals.

British Merchandising PTY. LTD.

A B.M.P. Company

60 Clarence Street, Sydney. BX 1571

nust realise that these devices are somehing of a contradiction. Operated vithin their ratings they are extremely obust and reliable, with a long life expectancy which many believe is almost ndefinite. But transgress their ratings, even momentarily sometimes, and—well, here's one transistor less in the world.

And while on the subject of transistor eliability, it is significant that most vorkers agree that, unlike the valve, the ransistor is the last rather than the first component to be suspected in a faulty tage. In other words, transistor failure s rare, unless as a result of some other ircuit failure or mis-handling on the part of the serviceman.

RANDOM PROBING

There are many ways in which operatng conditions can be upset. One is the nabit of probing indiscriminately at the viring and components with a screwdriver and of accidentally or deliberately shorting out components in the process. 'Screwdriver servicing" has no place in ransistor sets, not only because it is langerous but because it is unlikely to achieve anything.

It is dangerous because it can easily create wrong values of bias between emitter and base, resulting in destructive values of collector current. Even the surges created when certain components are shorted can be destructive. And it s unlikely to achieve anything because a mere 9 volts cannot produce a "splat" as we normally expect from a conventional HT line.

For the same reason it is unwise to disconnect any components, including the ransistors, while the set is switched on, or to switch it on with the circuit incomplete.

Even the soldering iron can cause rouble, quite apart from heat problems. A soldering iron without an earth wire (dangerous and inadvisable, anyway) may, due to leakage or inductive effects, develop several volts at the bit relative o earth. If the chassis of the set under test happens to be earthed via a generator or other device, it is quite possible hat dangerous voltages may be applied to the transistor elements.

"FINGER TESTING"

Another technique that must be discarded is that of "finger testing." A finger on the grid of a valve, particularly an audio stage, will produce some response in the speaker and an experienced worker can gain a good idea of the stage performance by this means. Not so the transistor stage. It won't do any harm but, due to the low impedance of transistor circuits, it won't produce any results either.

This means that we must resort to rather more precise forms of signal injection, using a suitable signal from the signal generator, i.e., RF, IF, or audio, according to the part of the set involved. But even here we must be careful. Whatever source of signal we use it must not present any DC voltage across its output terminals (unlikely, but possible n some cases) nor must there be a low value resistance path between them. The atter could short out vital sections just as effectively as a screwdriver.

The same applies to CRO's, signal racers, etc., which might conceivably be used.

In addition to signal injection, signal racing may be used by those who prefer this method, it being particularly appropriate where intermittent faults are involved.

After we have located the faulty stage it would be natural to check each likely component in that stage as a final step to locating the fault. Some of these may be most easily checked by substitution (such as the transistor) and others by measurement (resistors, windings etc.). Resistance, current and voltage measurements may all be used to this end but again, precautions are necessary.

SUBSTITUTES FOR JAP TRANSISTORS

HJ15 Replace by 2N217
HJ17 Replace by 2N217
HJ22 Replace by 2N218
HJ23 Replace by 2N219
2S45 Replace by 2N410
2S52 Probable replacement 2N412
ST12 Replace by 2N408
ST3C Replace by 2N408
ST16A NPN IF Amp. } **No direct replacement**
ST16B NPN Converter }

Type 2N585 may replace ST16A or ST16B, but would need careful checking.

Types 2N410 and 2N408 have higher gain than the types they replace. Circuit may need adjustment to avoid instability.

Many HJ types appear to have numbers similar to RCA, e.g., HJ15 and 2N215, etc.

For example, let us consider resistance measurement. Ohmmeters present voltage across their terminals; as high or higher than the receiver battery in some cases or, even when low, capable of passing substantial current through the external circuit. Either condition could be dangerous if unwittingly applied across transistor terminals in the process of testing—even if the set's own battery is disconnected.

For this reason, any component on which it is desired to make a resistance check should have at least one end disconnected from the circuit before this test is made. Alternatively, the transistor itself may be disconnected if this is easier. Remember that only two of the three leads need to be disconnected.

MINIATURE CAPACITORS

As well as the transistors there are the miniature low voltage electrolytics to be considered and, because of this low voltage rating, these also may be damaged by an ohmmeter. In particular, the application of reverse voltage must be avoided and the polarity of the ohmmeter should be clearly established.

In spite of what has been said above, it is suggested that ohmmeters can be used directly on components provided the voltage does not exceed three, and the maximum possible current 1mA. However, if in doubt, play safe.

Current readings are not particularly popular, due to the need to break the circuit concerned. However, a total current consumption test is easy to make, and may help locate a fault when there is a gross discrepancy. Some authorities suggest that this may be carried a stage further and each transistor removed in turn and the difference in current drain noted. (Note that it may be necessary to by-pass the meter with a high value, low voltage electrolytic to avoid upsetting performance.)

However, this is time consuming and would not appear to be justified in the general run of servicing. In addition, some circuits — such as direct coupled circuits — may not take kindly to operation with a particular transistor removed, since a following stage could draw excessive current.

In analysing individual collector current readings and attempting to nominate a likely cause of a wrong reading, it is worth remembering that a transistor behaves in exactly the opposite manner to a valve in regard to the effect of bias.

EFFECT OF BIAS

Lack of bias on a valve will cause excessive current, and excessive bias will cause reduced current, possibly cut-off. In a transistor it is lack of bias that causes cut-off, and excessive bias that causes excessive current flow. (Hence the term, "Forward Bias".)

Next voltage measurements. Because of the ease with which these may be made, this has always been a popular test. However, there are differences between the transistor set and the valve set.

In the case of a valve receiver it usually is possible to work without a copy of the circuit or maker's list of voltages of this is necessary; partly because most fellows are more familiar with typical voltages in such sets and partly because, if they aren't, reference to the nearest valve data book will supply at least a basis on which to work.

But transistors, being current operated devices, carry very little such information in their data sheets. Realising this, set manufacturers are publishing these voltages with their circuit diagrams, either as separate tables or directly on the circuit. For the sake of convenience, they are normally referred to chassis.

CIRCUIT DATA

In other words, manufacturers' data sheets are much more important in the case of transistor sets, at least for a start, than they are for valve type receivers. Fortunately, most manufacturers are perfectly willing to supply these, either free or for a nominal charge, to anyone having a genuine need for them:

In regard to the actual measurements, the type of voltmeter used must be considered. A high resistance type is essential in order to avoid shunting critical circuits. A 20,000 ohm/volt type would seem to be ideal, though a 10,000 ohm/-volt version probably would be satisfactory. Alternatively, a VTVM can be used if the ranges are satisfactory.

This brings us to a second point; the fact that a good many readings will be less than one volt and need to be read with at least a normal degree of accuracy. This applies particularly to the base-to-emitter bias voltage, which is quite critical.

This value will fall between .05 volt and .2 volt, with .1 volt as a typical figure. It may be read directly between

ZEPHYR

— MATRIX BOARD —

— NEW TYPES —

12 - 18 - 24

— HOLES WIDE —

12 HOLES — 3⅛ inches wide

18 HOLES — 4⅝ inches wide

24 HOLES — 6⅛ inches wide

—Obtainable in 3, 6, 9, 12 and 36 inch lengths—

From either TYPE "A" High Grade Bakelite (RF Quality) has very good insulating properties.

PRICES ON APPLICATION

or

TYPE "B" Good quality Bakelite.

SUITABLE FOR GENERAL USE

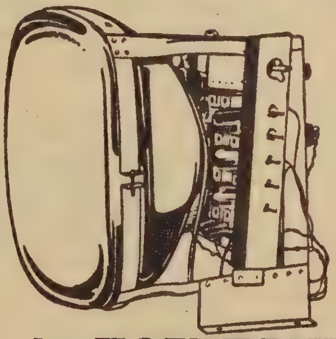
Type 282 Matrix
Terminal Pin Tool

Price £1/18/11 Retail.

ZEPHYR PRODUCTS Pty. Ltd.
58 High Street, Glen Iris, Victoria
Telephones: BL1300. BL4556.

COMPLETE TV CHASSIS £109-16-8

- * 21" side or front tuning, Astor parts.
- * 6 diodes used where applicable.
- * Fringe area set, 4—IF stages, 90 degrees short neck tube electrostatic focusing.



- * Guarantee does not operate until the first telecast.
- * Parts under guarantee replaced at your nearest capital city.
- * Set complete—knobs, optical filter glass, speaker, mask, nameplate etc.

P. A. EQUIPMENT

MAKE GREATER PROFITS — 15% BELOW COMPETITORS

- * Sound columns cast aluminium.
- * 6", 8" and 12" aluminium flares.
- * Reflex flares.
- * Sound cols. **"Slimline"** up to 8 Rola oval speakers.
- * Amplifiers 5/10 Mullard.
- * Amplifiers 20w ultra linear.
- * Amplifiers 30w ultra linear.
- * Other amplifiers 3w to 1000.

* Largest Suppliers of P.A. Equipment to Victorian Government.

MADISON T.V. **AUSTRALIAN SOUND & TELEVISION CO. PTY. LTD.**
218 George Street, Fitzroy, Melbourne, VICTORIA
JA5795 or JA3828

the transistor elements, or each element may be measured to chassis and the difference noted. In either case an accurate meter and a suitable scale is essential, and it is worth remembering that 10 pc of the typical figure is only .01 volt.

One glance at a typical meter scale will show that the conventional 10 volt range is quite useless, yet this may be the lowest available on some high sensitivity instruments. The 3 volt scale on most VTVM's is better, and may serve at a pinch, but a fair amount of "guesstimation" would be involved.

SPECIAL METER?

What appears to be needed is a meter specially designed for this job, based on, say, a 50 uA movement and having ranges of 1, 3, and 10 volts, and this appears to be one of the trends overseas. Another is the production of regular commercial multimeters having these ranges in addition to the higher ones.

Where a meter contains a basic movement of 50 uA or 100 uA and this range is readily available, there would appear to be no reason why an external multiplier box cannot be provided to give the ranges required. It would at least serve as a temporary measure.

Most VTVM's, on the other hand, are working fairly close to their maximum sensitivity when on the lowest range, and there is not much prospect of providing lower ranges by any such simple scheme.

Finally there are the purely physical problems peculiar to transistor sets. While not all transistor sets are ultra miniature, there is no doubt that the latter type has a very wide appeal, if only by reason of the sheer novelty of these devices.

Thus we find associated components getting smaller and smaller, and more and more of them being packed into less and less space. This can be disconcerting at first, but it is surprising how soon one becomes used to working to this scale.

TECHNICAL PROBLEM?

Perhaps, like many other readers, you have a technical problem and intend to write to us about it. Before you do, please study the panel on page 121. It indicates what is available through the query service and, equally, the types of request which we simply cannot meet, no matter how much we would like to do so.

Some scaling down of tools and other items is useful; a pair of tweezers, smaller pliers, test prods, soldering iron etc. will help a great deal to overcome the "all thumbs" feeling. Fortunately, we do not seem to have reached the point where a watchmaker's eyeglass is required.

Also, there are printed wiring boards to be considered, but these are not peculiar to transistor sets, and most of us have had a fair amount of experience with them already.

And that probably is about enough for one session. While fully aware that it leaves a lot unsaid, I hope it may prove useful as a starting point, and lead the reader to other and more comprehensive discussions.

a word in your ear

COMPERE

CONCERTS

HOTELS

HOSPITALS

CHURCHES

AWA Distributors for Queensland

AWA have a complete range of

PUBLIC ADDRESS SYSTEMS

to suit your requirements

- **AMPLIFIERS**

A series of amplifiers to suit any requirements, AC and Battery operated, from 5 to 70 watts. Built-in Radio reception with monitoring facilities can be provided.

- **SPEAKERS**

Reproducers for indoor to outdoor applications. Standard spun aluminium flares or line source column for difficult areas.

Flush and semi-flush architectural designs to suit modern trends.

- **MICROPHONES**

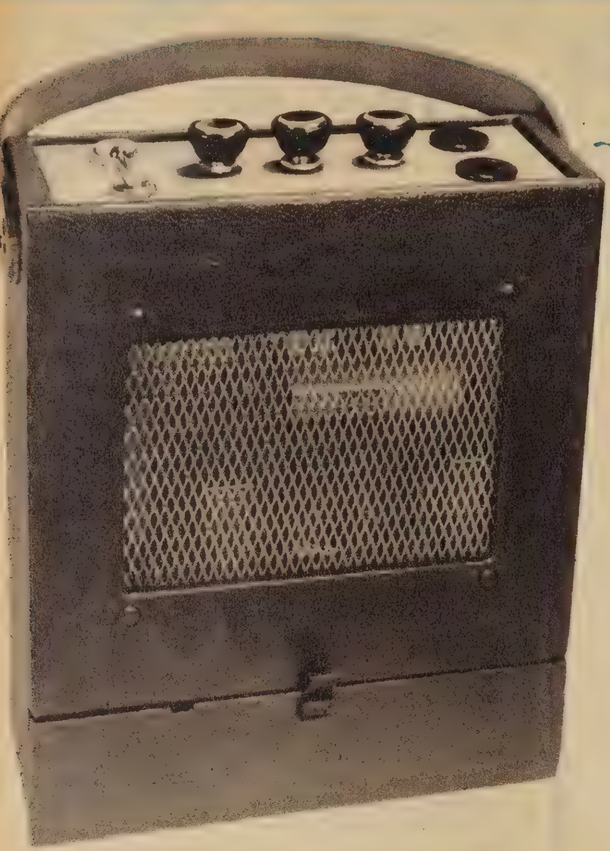
The Ronette and Reslo microphone range provides for all requirements. From the cheapest of crystals through the high quality multi-cell types to the outstanding Reslo Ribbon, Suitable for P.A. or broadcasting, this velocity microphone presents a programme as natural as the original.

AWA

Queensland, Northern Rivers and New Guinea readers please write, phone or call for special technical specifications to—

CHANDLERS

Albert & Charlotte Sts., Brisbane. 31 0341.



Here is our new transistor public address amplifier, complete in its carrying case. Off-on switch and speaker outlet are on the left, then the Tone Control, Volume Control 1, Volume Control 2 and, finally, the two input sockets at the right.

Transistor Amplifier-Part Two

The first part of this article, last month, described the design and construction of our new 10-watt public address transistor amplifier. In this article details are given of the carrying case followed, overleaf, by a discussion of operating transistor power amplifiers from an AC mains supply.

By Wes Yashin

AS was doubtless apparent from last month's article, our 10-watt transistor amplifier was designed from the outset for use, primarily, as a portable unit. This, as much as anything, influenced the shape and dimensions of the basic assembly.

It was decided, for example, that the unit had to be quite thin, on one dimension, so that it would hang naturally from the hand like a small attache case. It would therefore be capable of being carried and handled easily, even though, unfortunately, the same might not be said of the associated battery and loud speakers.

It also had to be capable of being carried in a car, possibly on the seat, without fear of rubbing the upholstery.

CARRIED IN CAR

In use, the amplifier might have to stand alongside the microphone, knobs upward, to ensure ease of control.

Alternatively, it might have to rest on a table, with knobs at one side, in more conventional fashion.

Based on past experience, one or two other points were given due consideration. Portable amplifiers, like this, are often operated from car batteries by simply lifting the car bonnet, clipping the leads on to the battery posts and resting the amplifier wherever it happens to fit.

There is a good chance in such circumstances, of the leads being conected to the battery the wrong way round. While this has always been a hazard to at least some vibrator-powered equipment, it could be ruinous to a transistor amplifier.

To guard against such a contingency, the original design provided for a silicon diode to be connected in series with one power lead. If connected to the battery the wrong way round, the diode simply does not conduct and the components in the amplifier are fully protected.

However, a diode cannot protect the amplifier against the second hazard, namely an accidental short-circuit between the metalwork of the amplifier and the frame of the car, when polarities are such that the former has to be "alive" by 12 volts.

COMMON WITH PORTABLE AMPLIFIERS

Again, this hazard is not peculiar to transistor amplifiers, having caused trouble at various times with vibrator equipment, similarly used.

To minimise the risk of such short-circuits, it is desirable to observe the following safety rules:

(1) The amplifier chassis should be housed in a non-conducting case such as wood, plastic or (perhaps) metal covered with a very substantial plastic cloth.

(2) The microphone cable must be rubber or plastic sheathed, with no bare braid exposed.

(3) Since the microphone case — and therefore the stand — is usually earthed via the cable to the amplifier, it should be kept clear of the vehicle body, unless it has been established that the car system uses a positive earth return. If the microphone case and stand can be isolated from earth without side effects, so much the better.

(4) Pickup leads should likewise be rubber or plastic sheathed. In addition, make sure that no metalwork to do with the motor and pickup assembly can rest against the car frame.

In line with the above requirements, or at least those which apply, a case was made up for the amplifier as pictured herewith.

COVERED WITH PLASTIC CLOTH

Fashioned from 3/8in and 3/16 plywood, it is covered with plastic cloth, in conventional fashion.

It will stand upright in the position shown, four rubber feet on the bottom keeping it clear of the ground or floor as the case may be.

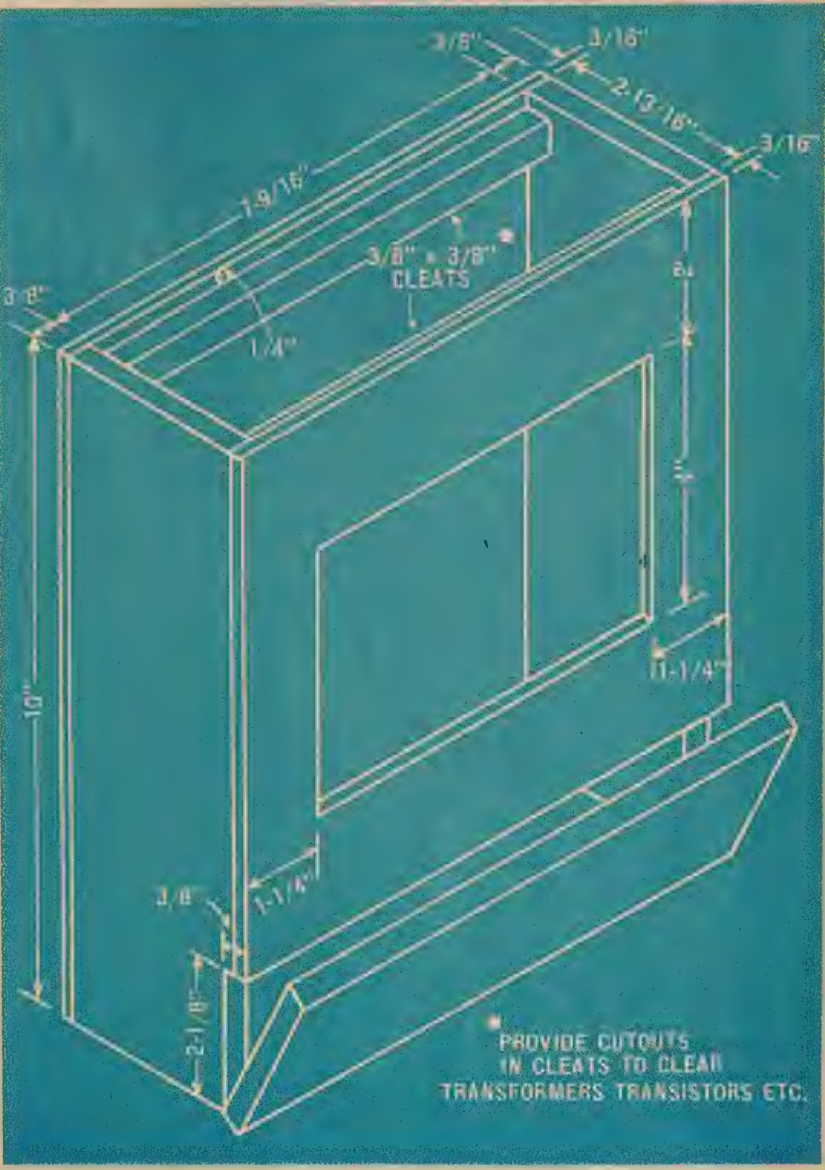
Alternatively, it can be rested on the side farthest from the camera, to which four more rubber feet are attached.

An ordinary leather strap serves as a carrying handle.

If desired, a shallow, hinged lid could be fitted to the top of the case and under the handle to protect the knobs, when not in use.

The cutout in the front is purely for ventilation and should therefore be covered with an open metal grille, NOT backed with cloth. A ventilation slot may not be strictly necessary in all cases but was included as a precautionary measure.

DETAILS OF THE CARRYING CASE



This sketch gives the essential dimensions for the prototype carrying case. Dimensions should be checked for individual units, however, to allow for slight variations in chassis and component dimensions.

Note that the cutout is on the side adjacent to the wiring components. If it were on the other side, there would be a distinct danger of the metal shorting to the bodies of the power transistors.

At the bottom of the case is a pocket designed to take the power cord, when the amplifier is in transit.

The amplifier chassis slides into the case, the front panel resting against narrow cleats just inside the top lip. As explained later, these cleats have to be fixed in position then cut away as necessary to clear the power transistors and certain other items on the chassis.

The lower corners of the chassis slip in between small wooden blocks, which hold it in position.

The construction of the case may well begin by marking out and cutting the individual pieces which are required.

The two sides are of 3/8in ply. Cut these slightly larger than necessary to allow for planing to their final dimensions. Planing the two pieces simultaneously will ensure that they are identical. At the same time, the two thicknesses will present a wider surface to the plane blade, making it that much easier to ensure that the edges are square.

SIMPLE ASSEMBLY

Note the step in the lower ends of these side pieces which accommodates the lid of the pocket at the lower end of the case. The depth of this step must include the thickness of the 3/16in ply panel.

The lid and the bottom of the case are also cut from 3/8in ply. The bottom piece will require suitable cutouts to act as hinge recesses, while the lid will need a small cutout to provide an exit for the power cable with the lid shut.

The two 3/16in sides may now be cut out in readiness to assembling the whole case. These overlap the 3/8in sides and need not be cut "on the mark"; any excess may be trimmed off after the glue has set. Do not forget the ventilation cut out in one of them.

The process of assembly is essentially simple, employing butt joints, which are held together by means of glue and panel pins.

The top edges of the 3/16in sides must be square, so that they may be used as a guide when marking out the position of 3/8in sides. Mark these positions then apply glue to the surfaces to be joined, rubbing the joint so as to force any air out. Without separating the surfaces, drive a number of panel pins into the joint to complete the job.

Treat the four corners of the case in like manner, attach the bottom and place it aside to set without further disturbing the joints.

The 3/8in square cleats which support the amplifier and the small blocks within the case may now be cut out. Do not attempt to file or cut any clearance holes in these cleats prior to assembly, though it is wise to avoid driving pins through where you will later want a recess. The job of shaping is easier after the cleats have been glued in place.

The blocks at the bottom of the case which prevent the amplifier from tipping within the case, are also attached when the case is complete. Insert the amplifier, and mark the position to be occupied by the blocks. This should be such that the chassis rests in the normal position with the transistors against the side of the case. Panel pins and glue are used to attach the blocks.

We have now reached the stage where, after edge trimming and sanding, the case should be ready for covering.

The whole case may be covered with a single piece of material, thus having a minimum of joins. The lid should be covered separately, and then hinged to the case.

We have used a vynil coated fabric to cover the case. This fabric may be stuck on with a variety of adhesives but the one we have found the most suitable and the easiest to handle is contact cement.

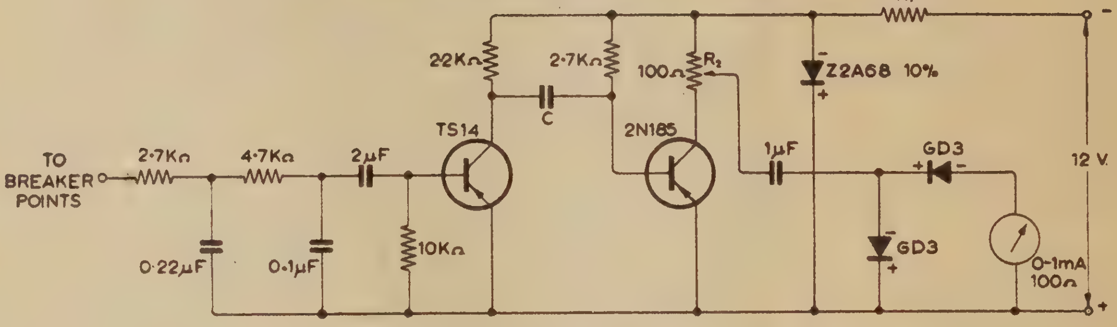
Due to the nature of the cement the action of joining two surfaces does not permit sliding the two surfaces into position. If the application instructions have been followed, an immediate and permanent bond is made at the instant the two surfaces meet.

EXTREME CARE IS ESSENTIAL

From the foregoing it is obvious that extreme care has to be taken in bringing the surfaces together. Make certain the surfaces are correctly aligned and in position, ironing out any bulges which could form permanent air pockets. When bringing the surfaces into contact do so a little at a time, ironing the contacted section with a small hand roller. If a roller is not available, a piece of large diameter metal tubing or a small bottle would do instead.

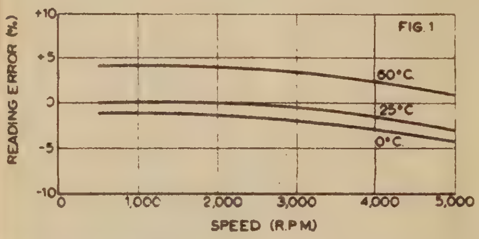
(Continued on Page 55)

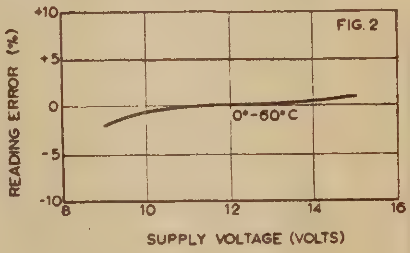
SETS THE STANDARD FOR TRANSISTORS



C = 0.5µF FOR 6 OR 8 CYLINDER ENGINES.
= 1.0µF FOR 4 CYLINDER ENGINES

R₁ - SEE TABLE.
R₂ - CALIBRATION CONTROL.





Australian-made S.T.C. transistors have proved their value in a vast number of applications. As the use of transistors grows, S.T.C., backed by world-wide research, is adding more new types to its already wide range. First to make transistors in Australia, S.T.C. keeps its lead in quality, reliability and performance.

TRANSISTORISED ELECTRONIC TACHOMETER

The circuit diagram shows an electronic tachometer which, although simple, gives very satisfactory results.

It has been designed for use with 12 volt systems having either positive or negative ground, and is relatively insensitive to variations in temperature and supply voltage.

Impulses from the breaker points are filtered by a CR network to remove spurious signals and are then applied to the first transistor, which is an amplifier-limiter. The output pulses are applied to the second transistor which operates as a switch. As a result, pulses of fixed shape are supplied to a counting circuit containing a meter which integrates them to give a meter reading directly proportional to the pulse rate.

A simple voltage regulator of the zener diode type compensates for supply voltage variations.

Figure 1 shows the meter reading error for three different temperatures, and Figure 2 shows the meter reading error, at all points on the scale, for a range of supply voltages and over the temperature range of 0°—60°C. The value of R_1 depends upon the exact voltage of the zener diode used and may be found from the table — see Figure 3.

TABLE FIG. 3

Zener diode Voltage (volts)	R_1 (ohms)
6.1 — 6.4	62
6.4 — 6.7	56
6.7 — 6.9	51
6.9 — 7.2	47
7.2 — 7.4	43
7.4 — 7.5	39
7.6	36

Full technical information and applications data are available for all transistors in the S.T.C. range—contact:

Standard Telephones and Cables Pty. Ltd.
SYDNEY MELBOURNE BRISBANE
*Reg'd T/Mk.

DISTRIBUTORS
S.A.: Unbehaun and Johnstone Ltd., Cornell Electronics Limited, Radio Electric Wholesalers, Adelaide; W.A.: M. J. Bateman Pty. Ltd., Perth; Tas.: W. & G. Genders Pty. Ltd.

W191

AC SUPPLY FOR TRANSISTOR AMP.

A notable advantage of much transistorised equipment is its ability to operate economically from batteries. However, the question of alternative operation from the power mains must inevitably arise and this article discusses the subject in relation to our 10-watt transistor amplifier.

By John Barker

WHILST this amplifier is primarily designed to be a portable unit, working from a 12 volt battery, occasions may arise when it is more convenient to use a mains operated supply as, for example, when used indoors.

In fact many smaller clubs and organisations may find it more economical to have the one amplifier, easily capable of performing a dual role; an amplifier which would normally operate in a fixed location, accessible to the mains but which would, on occasions, perform as a portable with a minimum of fuss and bother.

MAINS TYPE SUPPLY

These and other considerations lead us to produce the mains type supply to be described. In fact, the combination of transistor amplifier and mains power supply makes a very versatile unit.

The problems involved in the design of a low voltage, high current supply are numerous, if the size and cost are to be kept to a minimum. A discussion of some of the difficulties may be of interest to intending builders.

Since the output transistors are operated in class B, the average supply current varies with output power. In this case, the variation is approximately from ¼ to 2 amps. The power supply must provide this range of current, with as little voltage variation as possible.

If there is any undue variation in voltage with load, power output will suffer and the apparent distortion level will be increased.

The explanation is simple enough: As the input signal level rises, the class B stage tries to draw current proportionally. However, because the supply voltage simultaneously falls, the current — and output — fails to achieve the appropriate peak level.

The problem of changing voltage with varying current drain, referred to as the "voltage regulation," is almost negligible in an accumulator, because of its very small internal resistance.

TWO ASPECTS

In a mains type supply, two aspects of this regulation problem have to be considered.

One is its ability to deliver short-term current peaks as, for example, over a few high amplitude audio cycles. This might be described as a function of its "AC impedance," which can be minimised in value by using the largest practicable capacitor at the output of the filter system.

Its "storage effect" may then be adequate to sustain the supply voltage during isolated peaks of current.

However, the ability of the supply to deliver high average current without undue voltage drop over periods of sustained high level signals may better be described as a function of its "DC regulation." This is more a matter of the DC resistance of transformer, rectifier and filter, as well as the actual configuration of the filter system, whether choke or capacitor input. Again, the possibility and influence of various voltage regulating schemes must not be overlooked

Yet another trouble may arise from the "AC impedance" of the supply which is, of course, common to all the stages. At low frequencies a voltage may develop across this impedance of sufficient level and in the right phase to cause that well-known form of oscillation known as "motorboating."

Where the impedance cannot be reduced sufficiently by using a large final filter capacitor, it may become necessary to provide extra decoupling of some of the low level collector and bias circuits within the basic amplifier, or to make other minor changes to secure adequate stability.

Another problem is mains hum. As far as the push-pull stage is concerned, the output resistance is considerably higher than the load impedance, so that hum developed across the output load from ripple in the collector line will be proportionally reduced.

In any case, hum introduced into the collector and base circuits of the output stage will tend to cancel as an inherent property of the push-pull connection.

Hum in the base and collector circuits of the single-ended stages will be amplified, however, to an extent dependent upon the effectiveness of the applied negative feedback.

In the stages not included in the feedback loop, the hum level may become excessive, in which case it may be necessary to decouple the bias voltage divider, in particular, from the supply line when using anything other than battery supply.

So the basic requirements of the supply are low AC and DC resistance, and as little hum as possible.

Because of this and the relatively high figures of current involved, one must expect the transformer and choke equipment to be wound with heavy gauge

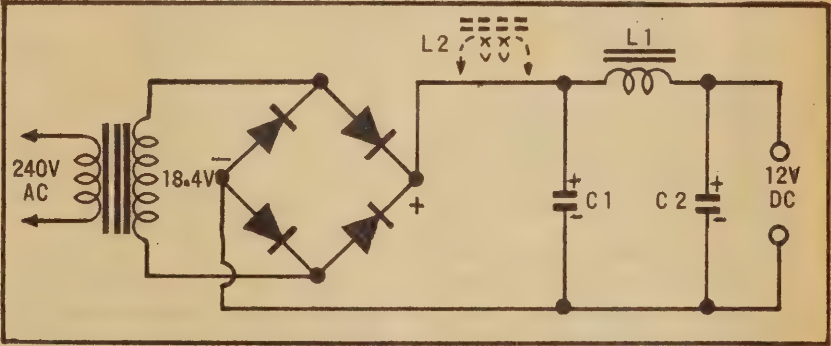


Figure 1: Initial experiments, as described in the text involved the use of a selenium type bridge rectifier with various types of filter circuit.

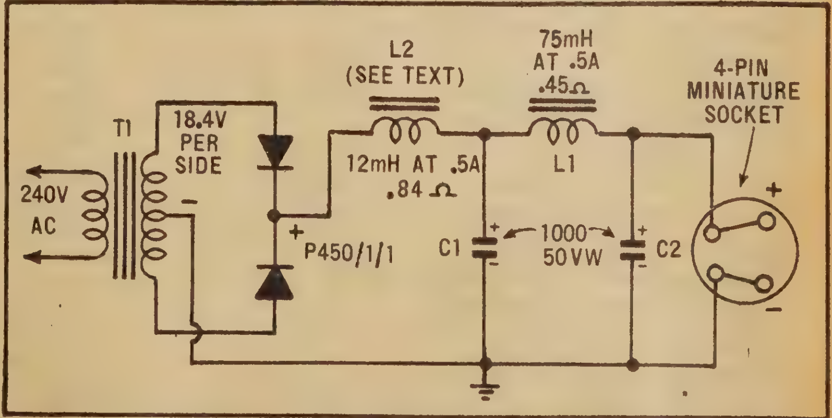


Figure 2: Here is the final power supply circuit, using a full-wave selenium rectifier and a two-section "swinging-choke" input filter system.

Homecrafts PTY. LTD.

Radio, Television & Hobbies SPECIALISTS

290 LONSDALE STREET MELBOURNE – FB 3811

HOMECRAFTS NEW MOTOR SCOOTER DEPT.

5 Sensational Models of the world's most popular Motor Scooter.

VESPA	125cc De Luxe	199 Gns
	125cc Special	234 Gns.
	150cc De Luxe ..	262 Gns.
	150cc Special	262 Gns.
	150cc Gran Sports	270 Gns.

Trade-ins accepted as part or full deposit.

Easy Terms from 52/6 weekly

ALL Vespa Spares and Accessories.

WHY WASTE YOUR HOBBY TIME IN LAWN MOWING?

Buy Australia's most popular Motor Mower.

VICTA Models from **49 Gns.** **or 7/6 weekly**

Limit No. QUALCAST

BIG CUT MOTOR MOWERS.
Normal Price, 45 Gns.
RADIO AND HOBBIES
Readers from
this month,

29 Gns.

These Mowers are brand-new.

OUTBOARD MOTOR SPECIAL!

2 H.P. £59/10/0

3 H.P. £69/10/0

Easy Terms available.

BOATS, The Famous UMIWATERSPITE 8ft. Aluminium, 79 gns. Easy terms available.

VISIT OUR NEW ENLARGED

BASEMENT SHOWROOM

ELECT., RADIO, TV AND HOBBIES BARGAINS

for Australia's Largest Range.

BARGAINS IN RADIO PARTS

£5,000 Surplus Radio Stocks Sacrifice. Call and inspect our Bargain Table.

BRAND NEW—Limited Number only.

THORENS AUTOMATIC PLAYERS

in original cartons. Model CB83N 19 Gns.

We pay freight within Victoria.

Call and See the NEW

NECCHI AUTOMATIC SEWING MACHINE

Easy terms available.

Trade-ins acepted as part or full deposit.

MAIL ORDERS PROMPTLY HANDLED

C.O.D. if you wish.

ROLA LOUDSPEAKERS

	£	s.	d.		£	s.	d.
2C	1	18	6	69L	3	9	6
3C	1	12	0	8H	2	10	0
4C	1	11	6	8K	2	12	6
4F	2	1	0	8M	3	3	0
4-5C	1	17	6	8MPA	3	3	0
4-5F	2	8	0	8MX	4	10	0
5C	1	13	6	10-3G	2	15	0
5CX	1	18	0	12K	3	6	0
5F	2	2	6	12M	4	1	0
5FX	2	5	6	12MX	6	16	6
57-H	2	8	0	12.0	6	0	0
57-L	3	3	6	12.0 De Luxe	6	10	6
6H	2	5	0	12-0X	11	4	0
6M	2	18	6	12UX	28	19	6
69H	2	15	0				

METAL CABINETS

Set of 16 Drawers. **48/6**

SUPER SPECIAL!

9 VALVE HI-FI AMPLIFIER AND TUNER CHASSIS

Well-known brand

To Clear £25

BRAND NEW. Thorens CB43N Auto Changers. £35

Imported Twin 3-watt Stereo Amplifier 25 gns.

Special 5-watt Amplifiers. Hi-Fi Bass and Treble Controls, £17/19/6.

Brand new high quality Extension Speakers. Attractive coloured leatherette cabinets. £3/10/. Plus 25 per cent tax.

SPECIAL. Cad. plated standard TV chassis, 5/. Plus tax.

TO CLEAR. Second hand Radiograms from £5

B.V. Super 90 Stereo PU Arm Demo Model. £16/16/.

Connoisseur Gram Motor VAR Speed Demo. £29/10/.

GE Var. Reluctance Cartridges, £2/19/6.

Elac Stereo Diam. Cartridge, used for Demo. £16.

3-way Speaker Crossover Filter. 5,000/800 cycles 15 ohm. £10/10/.

Goodmans Midax 400 Horn Speakers, used. £16/10/.

Kelly Ribbon Speakers Mk. I. New. £15/15/.

2 only Leak Diam LP Moving Coil pickups, perfect order. £16/10/.

MBH 16in LP Pickup, perfect. £10.

Connoisseur MK II 78 Diam. Stylii. £3/10/.

Ortofon AD Model Moving Coil. Pickup. Demo. model. £10/10/.

Ortofon RK309, used 16in Arms. Professional Model. £18/10/.

AZ FM Tuner, used. £16/10/.

Rogers Cadet Stereo Amp and Pre-Amp. Complete. Demo. model. 79 Gns.

Truvox Mk. III. Tape Deck. £45.

Truvox Stereo Hi-Fi Tape Heads. £22/10/.

Thorens DL 104 Pickup arm. Demo model. £8.

Wharfedale W15Cs Bass Speaker. £25.

Super Bargain Pye 91A. 15W Amplifier and Pre-Amp. £50.

Wharfedale W10CSB Speaker. Perfect order. £15.

Leak Pointone Pre-Amplifier. £24.

Garrard 301 Transcription. Motor used for Demo. £25.

and 100's of other Super Bargains.
WRITE US NOW.

STEREO RECORD PLAYING EQUIPMENT

We have everything for the Hi-Fi enthusiast

Grampian 590/2 Stereo Twin 8W.Amp	£91	0	0
Astronic Stereo Control	£48	1	0
Leak Stereo Point one Pre-amplifier	£60	0	0
Leak Stereo 20 Amp.	£87	0	0
Decca Stereo Pick-up	£42	0	0
Orpheus Std. Turntable	£29	17	6
Orpheus New Silex Turntable	£37	17	0
World Famous Dust Bag Record Cleaner	£2	13	11
BJ alignment Protractor for Pick-ups	£1	1	0

Wharfedale Speakers ex-Stock.

Super 3	£13	12	7
Super 8FS	£13	0	7
Super 8FSAL	£13	12	7
Bronze 8FSAL	£7	6	7
Bronze 10FSB	£11	0	0

Complete Range Fabulous Moving Coil Ortofon Pick-ups.

AD Model Complete	£12	12	0
A Model SAP LP	£18	0	0
New Stereo SP Head	£34	5	0

AVAILABLE ON EASIEST OF TERMS. CALL IN OR WRITE NOW.

vire and be of appreciable bulk. In act, a compromise must be reached beween cost and weight and the maximum olerable resistance.

The bigger the capacitors used in the upply, the more effective will be the ium filtering and the lower will be the mpedance at signal frequencies. These apacitors also would be unduly large tems but for the modern techniques ised in their manufacture.

Even so, the high value capacitors equired here are still almost as big as he old-fashioned "wet" electrolytics in ise 10 or 15 years ago, when 8uF was onsidered adequate for receiver power upplies.

LARGE CAPACITORS

A check with the manufacturers revealed that 1000 uF, 50 VW capacitors were readily available, thus simplifying the problem. They retail at round about 13/, which is expensive though not prohibitive. Any less capacity would be inadequate.

Our first developmental supply used a bridge-connected selenium rectifier with capacitor input filter, as shown in figure 1. The hum level was sufficiently low, but the regulation was poor.

If the low-load voltage was limited to a safe figure for the output transistors, it dropped to well below 12 at maximum signal, with a consequent reduction in power output.

If the full-load voltage was held to 12, then the voltage without signal was too high for safety.

Removing the input capacitator allowed much better regulation, but now the hum level was high.

A second choke, L2 (shown dotted), was then wired in. Here the good regulating quality of the choke input was combined with the good smoothing ability of the capacitor input filter. The results were fairly good.

This second choke is physically quite a small one, and its inductance tends to decrease markedly as the current through it rises. In other words, it acts as a so-called "swinging choke."

PARTIAL CHOKE INPUT

At low current drain, the filter acts as a choke-input type, giving limited output voltage. At higher orders of current drain, the system approaches the capacitor input condition, the resultant rising output helping to offset the extra DC drop.

One trouble with bridge-connected rectifiers is that during any part of the cycle, two of the individual rectifiers are always in series; whereas, with the conventional push-pull connection and centre-tapped transformer, only one rectifier element at a time is in the conduction path.

As far as the rectifier is concerned, there should therefore be some advantage in the push-pull configuration, because of lower rectifier resistance.

The advantage will be offset to some extent by the fact that a higher voltage secondary winding is required, which may need to be wound with lighter gauge wire. However, other losses in the transformer remain constant, and it would appear that the difference in overall transformer "resistance" is really quite small.

We tried this arrangement, as shown in the final version, and its regulation had improved enough for us to accept this as our basic circuit. A further advantage is that the rectifier is a cheaper type, retailing at round about 20/.

The rectifier shown in the photograph is actually the one used in the bridge circuit. It is called a bridge "stack." We used the inside two rectifiers of this stack when trying out the push-pull version. The simpler push-pull unit had not arrived in time for our photograph.

An examination of the forward characteristics of both selenium and germanium rectifiers indicates that the OA31, a fairly new germanium type, would be more satisfactory in this circuit by virtue of its lower forward resistance.

Accordingly, we wired a pair into our circuit with a very slight improvement in the regulation characteristic. However, in view of the fact that a pair of them cost about four times as much as the selenium stack, we considered their inclusion hardly justified in the present case.

For those builders who will want to use them anyway, they are available through the normal trade houses. The selenium rectifier is an S.T.C. type which can be ordered through your local supplier.

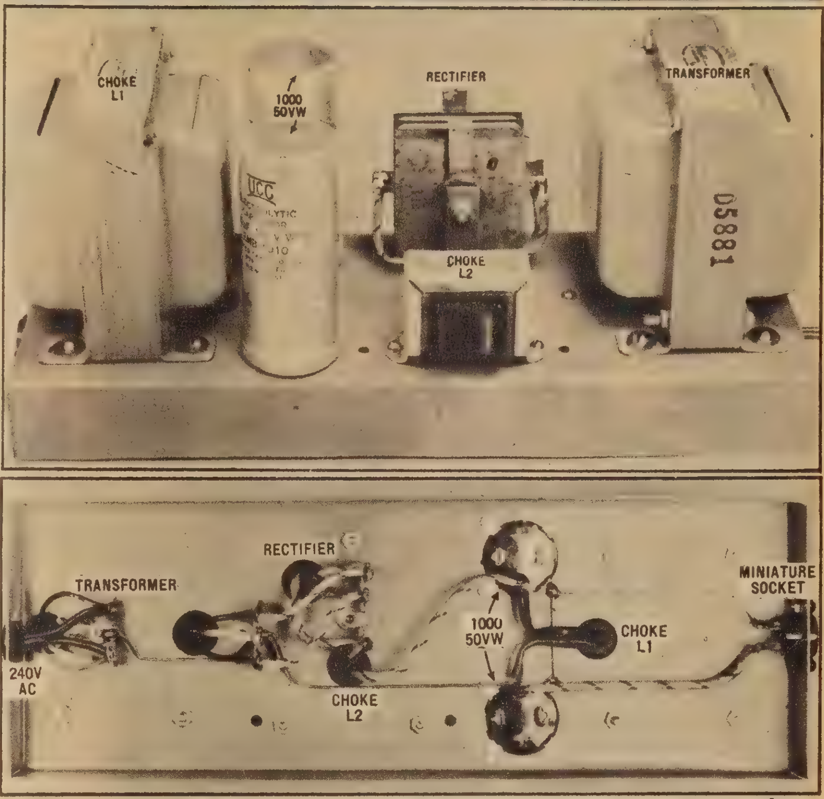
WINDING DATA

The "swinging choke" used in our prototype, and shown in the photograph, was wound in our own workshop on a core found in our "junk box," and it proved highly satisfactory. (We realise that our "junk box" must seem almost bottomless, but it really is surprising how much does accumulate over the years.)

The lamination tongue size was 9/16in. and the core depth was 5/8in. We wound on five layers of about 28 turns each of 22 B and S enamel-covered wire, and finally interleaved the laminations to make the core saturate easily at high current. Its resistance is 0.84 ohms.

There is every chance, however, that by the time this article goes to press,

LAYOUT OF AC POWER SUPPLY



These two photographs show the layout of the prototype power supply. Actually the components could be arranged to suit individual convenience and housed in a box or carrying case.

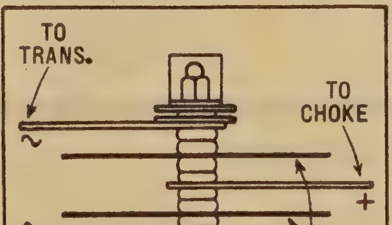


Figure 3: This diagram shows the terminal connections to the selenium rectifier specified.

A TRUE HIGH FIDELITY MACHINE without compromise in quality or features

140 gns.

140 gns. is an amazing price for a professional Hi-Fi tape recorder . . . and it's real value! TRUVOX is one of the recognised top-quality professional machines — it has everything: level frequency response between 50-12,000 cps, ± 3DB, push-button controls, level indicator, accurate place locator, two speeds (3¾ and 7½ ips), records and amplifies from AM and FM receiver or tuner, can be used as pre-amplifier. Supplied complete with microphone and tape.

TRUVOX

DISTRIBUTED BY BROWN & WATSON ELECTRONICS PTY. LTD.,
281 LATROBE STREET, MELBOURNE. PHONE MU 8186.

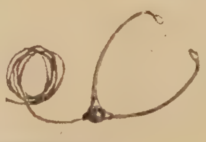
PROVISION FOR FOOT CONTROL
INPUT JACKS FOR MIKE AND RADIO/PICK-UP
OUTPUT JACKS FOR FEEDING ANOTHER AMPLIFIER AND EXTENSION SPEAKER.

STEREO RECORDER
ONLY 200 GNS. COMPLETE!

The TRUVOX stereo tape recorder consists of two units. The recorder/playback unit has all the professional features to make your own high quality stereo recordings. The second unit contains another amplifier and speaker. Supplied complete with two microphones and tape.

COMPLETE RANGE OF ACCESSORIES

RADIO JACK
Plug in, and the TRUVOX recorder receives radio signals



EARPHONES
For monitoring or private listening

STEREO HEAD
To convert single track TRUVOX tape recorders

FOOT CONTROL
Ideal for dictating notes or correspondence

TRUVOX TAPE DECKS AND AMPLIFIERS

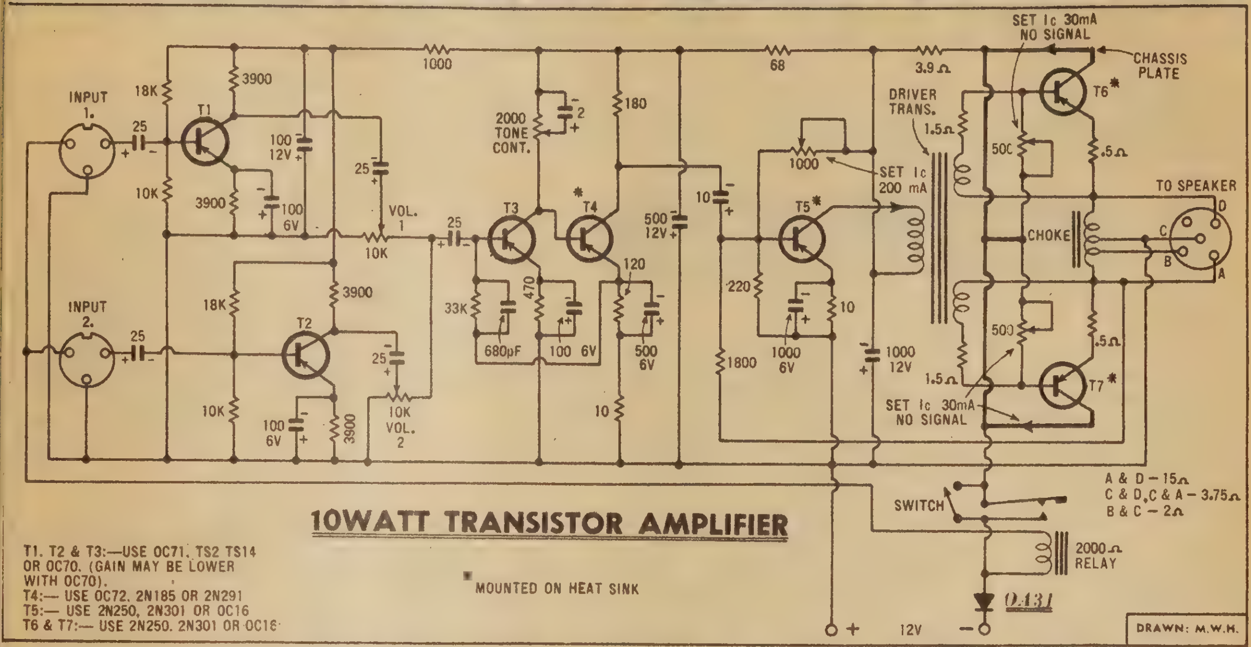
£45 *HI-FI AMPLIFIER WITH LEVEL INDICATOR AND POWER PACK*

£55 *TAPE DECK WITH TIMING SCALE AND PUSH BUTTON CONTROL*

APPOINTED RETAILERS

Melbourne Tape Recorders
Magnetic-sound Industries, Sydney
Maxwells (Melbourne)
Fonnetta Electronics, Parramatta

SLIGHT CHANGES SIMPLIFY MAINS OPERATION



Here again is the circuit diagram of the 10-watt transistor amplifier but slightly modified to simplify its operation from an AC mains type power supply. See text for details.

a suitable choke will be available commercially, along with the transformer and main filter choke as pictured.

The photographs of our prototype supply indicate clearly our method of construction. The chassis dimensions are 4in. x 11¼in. x 1½in. deep.

The actual layout, however, is not in any way critical. The components can be arranged in any way to fit an available box. We chose a long and narrow chassis simply because we thought it might make for easier handling.

The amplifier, when operating from the supply as it stands, is perfectly satisfactory. Its performance is identical, for all practical purposes, to when it is operating from a battery. Even so, we feel that the last word has not been said.

There is a possibility, for instance, of improving on the swinging choke idea; perhaps increasing its size and reducing the main filter choke. This, in conjunction with a smaller self-regulating transformer, might well decrease the overall bulk.

REGULATED SUPPLY?

Another possible scheme is that of using a transistorised regulated power supply with a series power transistor. Such schemes may take time to develop and, in any case, may be costly. Only time will tell.

In the meantime, the present model fulfils an immediate requirement quite satisfactorily.

Throughout these experiments, we experienced some difficulties with amplifier instability. This was to be expected, for the reasons mentioned earlier. However, with the supply in its final form, only minor changes are necessary for the trouble to be completely eliminated.

The amplifier circuit is reprinted in this issue with the necessary modifications included. In fact, we recommend that this modified circuit be used, anyway, even if it is only intended to operate from a battery.

Note that the coupling capacitor to the base of the driver transistor has been reduced to 10 uF, and the decoupling capacitor for the previous stage to this, T4, increased to 500 uF.

The reduction in bass response due to the decreased coupling capacitator is hardly noticeable, the lower 3db point being still about 80 cps.

Further tests have indicated that the 1500 ohm resistor in the base circuit of the driver transistor, T5, may be deleted altogether, no matter which transistor type is used. With it in circuit, some difficulty may be experienced in setting the correct quiescent collector current with many typical transistors.

TRANSISTOR AMPLIFIER CABINET

(Continued from Page 49)

As a further precaution against incorrect or premature bonding, a piece of waxed paper may be inserted between the two surfaces and gradually withdrawn, exposing a minimum of surface to be bonded.

The usual method of making joints in the covering material is adhered to. Overlap the sections to be joined, then slice through with a sharp razor and a ruler as a guide. The excess material may now be peeled off and the two new edges brought together.

Surplus adhesive may be removed from clean surfaces with lacquer thinner or mineral turps. Improperly made joins, particularly on edges and in corners may be readily masked with a P.V.C. lacquer which is made to match the basic colours of P.V.C. covered fabric.

Having covered the case, the next step is to fit the lid and other odds and ends to complete the project.

Small brass hinges, recessed into the outermost edge of the bottom piece of the case should be adequate to support the lid. A cupboard type of spring catch on one side of the case and lid should serve to keep the lid normally closed.

Rather than place an awkward knob on the lid, we used a length of the covering material about one half inch wide and doubled for about ¾in, the doubled section was bonded together with contact cement and the whole held in place by a little strip of metal.

Since the cutout in the side of the case is intended for ventilation purposes, a piece of expanded aluminium rather than backing cloth must be used. To attach the aluminium to the panel, we used a set of bifurcated rivets, one in each corner.

The split ends of the rivets may be spread initially with a screw driver then beaten flat with a piece of tubing or rod inserted into the cabinet. To provide the necessary leverage for the rod, place the outside end on a hard object of greater thickness than the combination of expanded aluminium and the side of the case. Strike with a hammer along the rod as close to the case as is possible.

The rivet heads must naturally be resting on a hard surface when this is done.

A set of rubber feet or panel buffers where necessary, as well as a leather carrying strap should complete the finishing touches to the case.

NEW *Releases!*

CLASSIC RADIO TAKE PRIDE IN ANNOUNCING COMPLETE NEW RANGE OF MONAURAL AND STEREOPHONIC EQUIPMENT

Stereophon LIVING SOUND

---

16 VALVE HI-FI STEREOGRAM CHASSIS

Complete tuner and amplifier for stereo, comprising a compact Hi-Fi Stereogram in two units featuring a high gain dual wave tuner with tuned R.F. stage, multi-input two channel pre-amplifier with tone controls in one unit and two Mullard 5-10 amplifiers with push-pull outputs and power supply on second chassis. **£69/15/-** F.O.R.

Two pair of M.S.P. Jensen speakers or two Rola 12in dual coned speakers supplied. Power output 10 watts per channel (20 watts). Frequency response of amplifier 40 to 15,000 cycles.

---

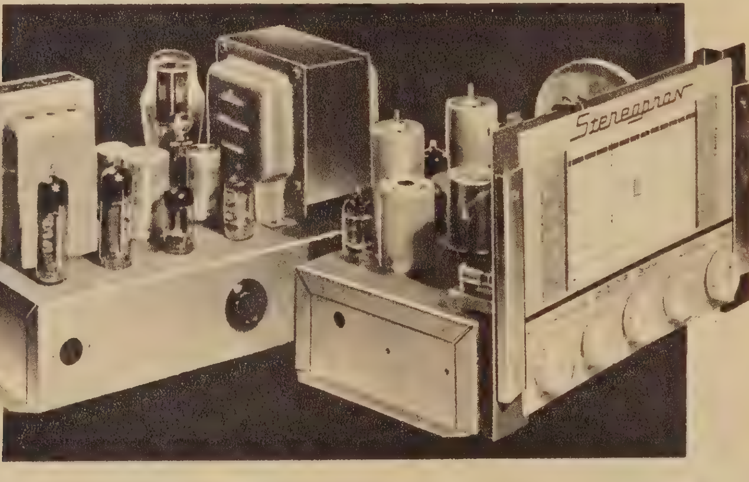
10 VALVE HI-FI STEREOGRAM CHASSIS

Complete stereo unit comprising dual wave tuner with tuned R.F. stage, multi-input two channel pre-amplifier with tone controls and two Mullard 3-3 amplifiers, power supply on separate chassis. Supplied with two Rola 8MX speakers. Power output 4 watts per channel. Frequency response of amplifier 40 to 15,000 cycles. **£48/15/-** F.O.R.

---

8 VALVE HI-FI STEREOGRAM CHASSIS

Complete tuner and amplifier for stereo incorporating the "Mullard 3-3" amplifier circuit with separate bass and treble controls. Output 3 watts per channel. Supplied with two Rola 8MX speakers. Frequency response 50 to 10,000 cycles. **£38/15/-** F.O.R.



ALL UNITS INCORPORATE THE NOW FAMOUS "MULLARD" AMPLIFIER & TONE CONTROL CIRCUITS.

SPECIFICATIONS ON OPPOSITE PAGE

A NINE VALVE HIGH-FIDELITY RADIOGRAM CHASSIS

Nine and ten valve chassis incorporate the Mullard 5-10 AMPLIFIER CIRCUIT. Frequency response 40-13,000 cycles. Max. output 10 watts.

£42/15/0 F.O.R.

A NEW 10 VALVE DUAL WAVE RADIOGRAM CHASSIS

WITH BASS AND TREBLE BOOST.

The ideal chassis for those difficult locations where reception is doubtful. Specifications as nine valve unit, but with the addition of high gain tuned R.F. stage giving greater sensitivity and selectivity on both broadcast and short-wave bands.

£45/15/0 F.O.R.

ALL CHASSIS GUARANTEED FOR A PERIOD OF SIX MONTHS. ALL 4-SPEED STEREO RECORD CHANGERS AND PLAYERS STOCKED.

Classic Radio

245 PARRAMATTA ROAD, HABERFIELD, N.S.W. PHONE UA2145.

Buying a Tape Recorder?

First see and hear the new Hi-Fi Recorder by Classic incorporating the new Collaro Mark IV Transcription deck. The only deck with ALL these features.

THE COMPLETE UNIT IS SUPPLIED IN ATTRACTIVE AND DURABLE TWO-TONE COVERED CASE COMPLETE WITH ACOS MICROPHONE AND FITTED WITH DUAL ROLA SPEAKERS.

The seven-valve amplifier, including level indicator, incorporates the latest "Mullard" tape recorder circuit equalised to C.C.R. standards giving perfect reproduction from recorded tapes. Record monitoring and outlet to power amplifier. Extension speaker outlet and "magic eye" level indicator. Amplifier is completely shielded and fitted with perspex dress plate to match deck.

- **HIGH FIDELITY**
Heads are double coil wound and will reproduce up to 12,000 c.p.s. at 7½ inches per second. Azimuth adjustments on both impedance "record" and "playback" heads. Output of heads is approximately 5 milli-volts at 1 Kc at 7½ inches per second.
- **INSTANTLY REVERSIBLE**
Instantaneous changes can be made from one track to the other. Fast rewind in either direction.
- **CONSTANT TAPE TENSION**
A special Collaro device ensures a constant tension on the tape on the take-up spool as it leaves the capstan.
- **FULLY MECHANICAL**
No solenoids are used in the construction of this Transcriptor. The braking is entirely mechanical.
- **FINISH**
Cream Polystrene cover plate with maroon controls.
- **THREE SPEEDS**
3¾, 7½ and 15 inches per second.
- **FOUR HEADS**
Two "Record/Play-back" and two "Erase" heads are sited on two different levels and head wear thus halves for any given length of track.
- **TWIN TRACK OPERATION**
One pair of heads for each track. Both top and bottom tracks can be recorded or played back without removing tape.
- **PAUSE CONTROL**
This has the effect of stopping the transit of the tape past the "Record/Play-back" and "Erase" heads and applying the brakes to the spools while leaving all switches and mechanical functions in their selected positions. Typical application is to pause whilst recording to omit speech interposed between musical selections. Control will only work whilst it is held in position.
- **TAPE MEASURING & CALIBRATING DEVICE**
The three digit counter makes the location of any recorded passage the simplest of operations.
- **TRANSCRIPTION TECHNIQUE**
A large diameter flywheel with ground and lapped steel shaft running on a ball at the bottom of long bearing reduces friction and virtually eliminates "wow" and flutter at less than 0.15 to 1.0 per cent.
- **TWO MOTORS**
Each dynamically balanced motor does only one job at a time. Motors never act against each other and are of low wattage input with consequent reduction in heat and wear.

COMPLETE RECORDER WITH MIKE — 84 GNS. f.o.r.

DECK WITH AMPLIFIER, POWER SUPPLY and 6in x 9in SPEAKER, 71 GNS.

AMPLIFIER AND POWER SUPPLY FOR COLLARO DECKS WITH VALVES (7) £34/10/- f.o.r.

SPECIFICATIONS OF OUR NEW HI-FI CHASSIS

NEW:

Ultramodern circuit using nine high gain valves including "magic eye" tuning indicator. Permatuned iron cored coils and intermediates giving excellent interstate reception and a short-wave range of 12,000 miles. All valves used are the new Mullard nine-pin Innoval series.

NEW:

Tone control and audio stages incorporating the Mullard 5/10 amplifier circuit with separate bass and treble controls giving plus or minus 15 db boost or cut at 50 cycles L.F. and 10,000 H.F., combined with push-pull output with inverse feed-back gives you really high fidelity reproduction from your radio or favourite recordings.

NEW:

Dual speaker combination using the new Jensen M.S.P. 12PR woofer with matched tweeter and cross-over network giving a frequency response of 40 to 12,000 cycles. If required the Rola 12MX speakers can be supplied (with the 8 valve stereo chassis, two Rola 8MX speakers are supplied). A.W.A. output transformers used on all units.

NEW:

Six position selector switch is incorporated in all chassis with compensation for L.P. recordings and provision for stereo F.M., or TV tuners and tape recorder.

NEW:

Large calibrated edge-lit dial in perspex (11in x 6in) with main stations of each State in prominent type. Dial fitted with counterweight drive, giving smooth tuning. Dial can be supplied in cream, black or brown with matching knobs and escutcheon to suit contemporary blond or walnut finished cabinets.

NEW:

Sensitive 'magic eye" tuning indicator (EM80) making tuning simple and positive even on interstate overseas and country stations.
All chassis are wired for the fitting of F.M. tuner or tape recorder, special plug being provided on back of chassis, also pick-up terminals and outlet for gramo. motor.
Power switch is fitted to volume control. Audio end of set can be used with TV receiver if required.

Classic Radio

245 PARRAMATTA ROAD, HABERFIELD, N.S.W. PHONE UA2145.

MASTER ELECTRICS PTY. LTD.

A WHOLLY OWNED
SUBSIDIARY OF
MOTOR SPARES
LTD.

TESTER BOY MULTIMETER

The Tester Boy Multimeter is ideal as a portable instrument for the hobbyist, motor mechanic, etc. Dimensions are 6in high, 2 3/8in wide and 3 5/8in deep.

Weight 1lb 13oz.

Ranges as follows—
Volts AC and DC 2.5, 10, 50, 250, 500, 5000.

Resistance 0-10,000 ohms; 0-100,000 ohms and 0-1 meg ohm. Decibels minus 20db to plus 10db to plus 22db. By referring to a chart up to plus 56db may be measured. The case is black bakelite with a metal panel and 3in meter. Test leads are provided and also a leather carrying case. Sensitivity of meter is 1,000 ohms per volt.

Price of this Unit is £7/10/.

Transistor Set Builders—Write for price list of transistors, miniature condensers, speakers, potentiometers, matrix boards, etc.

HANSEN MULTIMETERS

Especially designed for Radio and Television servicing, these meters may also be used for Transistor service, etc.

Model F.N.

Similar to the T.S., but sensitivity of meter 20,000 ohms per volt D.C. 5000 ohms per volt A.C.

Ranges:
D.C. Volts 0-0.28, 7.35, 140, 350, 700.
A.C. Volts 0-1.4, 7, 35, 140, 350, 700.
High Volts D.C. 0-1400, 7000, 28,000.
High Volts A.C. 0-3,500, 28,000.
DC mA 0-7, 140.
DC Microamps 0-50.
RE Volts 0-14 RMS 0-40 Volt P.P.
DB -20 to plus 59.
Ohms 0-5000, 500,000, 50 meg.
Microfarads 0-0.03, 0-6.
Henries 0-5, 500.

Also Tests for tube emissions, etc. All test prods, etc., provided. **Price £15 plus** 12½ p.c. sales tax. **Total £16/17/6** plus postage.

TECH MULTIMETER

Model PT34.

Overall size 3¾ x 2 3/8 x 1¼ inches. Sensitivity of Meter 1,000 ohms per volt AC and DC Voltage Range 0-10, 50, 250, 500, 1,000.
D.C. Current Range 0-1ma, 100ma, 500ma.
Resistance 0-100,000 ohms.

An efficient meter at a cheap price.

Price only 61/-

★ SPECIALS ★

1 **Long Playing Recording Tape** 1,800ft on 7in Spool. Good quality. Brand new and boxed. **Only 45/ each.**

2 **Lightning Arrestors** for television, can be mounted either inside or outside house. Suitable for all types of lead, flat ribbon, open line or coaxial. All mounting screws etc. supplied. **Price only 5/6 each.**

3 **Single Crystal Earpieces** as used for Japanese Portables, Crystal sets, etc. **Price only 12/6 each.**

4 **Resistors 1 Watt Carbon.**
350, 390, 400, 450, 500, 600, 680, 800, 850, 1,500, 3,000, 4T, 5T, 6T, 7T, 12T, 15T, 18T, 25T, 40T, 56T, 75T, .15m, .3m.
Price 4d each, 3/ doz. or £1 per 100 Assorted 1 Watt.

5 **Resistors ½ Watt Carbon.**
300, 320, 450, 500, 600, 750, 800, 850, 880, 900, 990, 1,000, 1,300, 1,700, 1,800, 1,900, 2,000, 3,200, 3,500, 7,900, 8,000, 10T, 60T, 90T, 15T, 25T, 37T, .15m, .16m, 13.35, ½ meg. **Price 3d each, 2/6 doz., 16/8 per 100 Assorted ½ watt.**

6 **Resistors** 20W Wire Wound 50, 75, 125, 150, 175, 200, 250, 300, 400, 750, 1,500, 1,750, 4,000 ohms, **2/ each.**

7 **Resistors** 25W Wire Wound, 50, 75, 100, 125, 175, 200, 300, 400, 1,250, 7,500 ohms. **2/6 each.**

8 40ma. Power Chokes No. 108. **Price only 4/3 each.**

9 **Extra Special.** Brand new 40ma Power Transformer.
Primary 0 - 230, 240
Secondary, 240 volts aside.
Filament 6.3 volts at 2 amps.
Worth 54/. **Our price 27/6 each.**

10 **100 ma. Power Transformers.** Brand new and Boxed.
Primary 240 volt
Secondary 350 volts aside 100 ma
40 volts at 1 amp.
Filament 6.3 Volts CT and 3 amp
5 Volts at 2 amps.
Vertical Mounting type. Worth £4/10/.
A very good buy. Only 39/6.

11 **Television Power Transformers.** We have a few of these as follows.
(a) Low voltage Type.
Primary 230 volts.
Secondary 240 aside at 300 ma.
Filaments 6.3 at 9 amps.
5 volts at 3 amps.
Suitable for **sets** using Philips valve **series. £5**

(b) High Voltage Type.
Primary 230 volts.
Secondary 290 aside at 300 ma.
Filaments 6.3 at 9 amps.
5 volts at 3 amps.
Suitable for sets using Radiotron valve series. **£5/10/.**

12 **Silicon Diodes.** Ideal for voltage doubler circuits for TV use etc. Will carry up to 400 ma. **Price only 18/6 each.**

13 **Germanium Diodes.** English make. Brand new and perfect. Ideal for use in crystal sets, for radio detectors, rectifiers etc. **Price only 3/11 each.**

14 **Transistors** are available as follows.

OC44	**38/**	**TS3**	**28/9**
OC45	**36/7**	**2N185**	**31/6**
OC71	**27/**	**2N250**	**58/3**
OC72	**66/6 pr.**	**2N252**	**37/6**
TS1	**24/3**	**2N308**	**35/6**
TS2	**27/9**	**2N309**	**37/6**

15 **Low tension Iron Cored Chokes** as used in Vibrator Mantels. These are useful for rewinding for filament output transformers. etc. Worth 15/. **Our price only 2/6.**

16 **Speaker Windings.** A large variety of these are available to suit all popular makes of speakers. When ordering let us know size and make of speaker and primary impedance of old transformer. **Price only 1/11 each.**

17 **30-0-30 Zero Centre Ammeters.** 3½-inch diam., moving coil, brand new and boxed. Worth £4/10/. **Our price, 30/.**

18 **250 Relays with 1-SP and 1S.P.D.T. Switch.** Brand new P.M.G. type. **Price only 5/9 ea.**

1000V
150V
15V

KEW MULTIMETER

Size 4in x 2½in x 1¼in complete with Test Prods. Ranges AC and DC volts 0-15, 150, 1,000.

DC Current 0-150mA.

Resistance 0-100,000 ohms.

Sensitivity, 1,000 ohms per volt. An ideal pocket meter for the serviceman, motor mechanic, home constructor, etc.

Price only £3/19/6.

SPECIAL NOTICE

All parcels sent Registered Post unless otherwise stated. Postage or freight must be included with order.

547 ELIZABETH STREET, MELBOURNE — Phone FY0271
Branches throughout Victoria and Riverina

A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

AN ELECTRONIC TACHOMETER

There have been many inquiries for the circuit on an electronic tachometer over the past few months. We have not had the opportunity to work on the design of an instrument in our own laboratory so far but this contribution from Mr J. Monotti of 1B Kinkora Rd., Hawthorn, Vic. may be of interest.

Our correspondent says:

"The circuit shown is that of an electronic tachometer; basically it is a pulse rate counter employing a monostable multivibrator circuit, the collector current of T2 measuring the average switching rate of the transistors and hence the average input pulse rate, which, of course, depends on the engine revolutions.

"Similar circuits have been seen but none approaches this one for simplicity and economy. The input pulses are obtained by taping about ¾in of coaxial cable (the outer plastic cover and braid shielding having first been removed) to the lead from the secondary of the coil to the distributor. This does away with the need for high voltage capacitors.

"The supply voltage for the transistors is taken directly from the car battery in the case of 12-volt systems; for 6-volt systems a dry cell (or some other source) of approximately 4½ volts must be inserted in series with the car battery. This is to allow the Zener diode to operate satisfactorily as a stabiliser for the voltage to the transistors. The 470-ohm load resistor may need to be varied slightly to ensure linearity on any individual instrument.

"The device may be calibrated either directly, using a mechanical tachometer as a standard, or indirectly, by means of a pulse generator and C.R.O., thus; each revolution of the engine produces a number of pulses from the secondary of the coil equal to half the number of cylinders in the engine. Hence the number of pulses per second, p., equivalent to r.p.m., r., of the engine is given by:

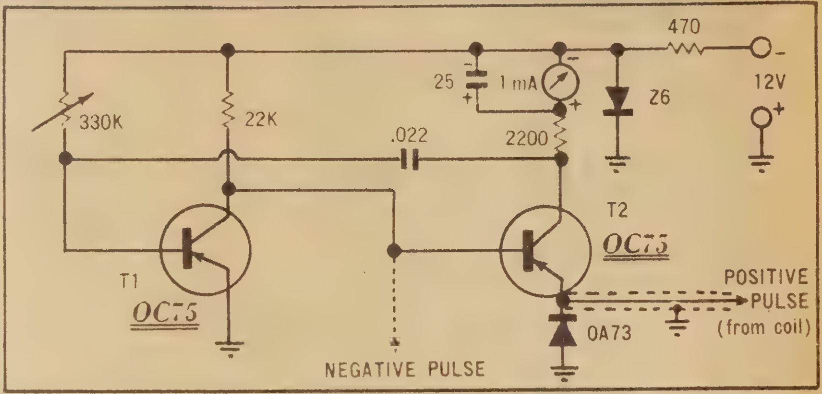
$$p = \frac{nr}{120}$$

where n=number of cylinders in the engine, e.g. for a four-cylinder car, 3,000 r.p.m. is equivalent to 100 pulses per second.

"The number of pulses per second from the generator can be accurately determined by observing the Lissajous figure on the C.R.O. screen. If the X plates have 50 c.p.s. (from the mains) applied to them, then 50 p.p.s. applied to the Y plates will produce one stationary pulse on the screen, 100 p.p.s. will produce two and so on.

"The pulses from the pulse generator are fed to the input of the circuit via

(Continued on Page 79)



Largest component in the tachometer is the meter which could be chosen to suit the layout of the other instruments in the vehicle. The remainder of the parts could be fitted in a very small space.

READER SUGGESTS DISTORTION METER CALIBRATION

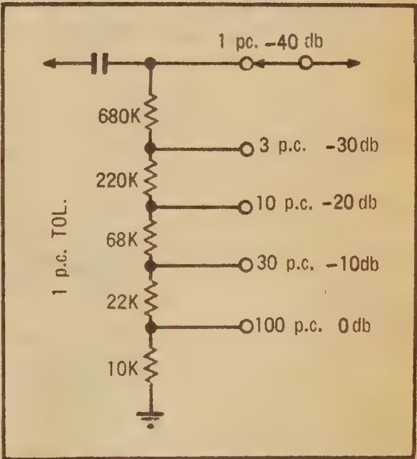
Greater convenience in the use of the R., TV & H. Distortion Meter described in the July issue is claimed by Mr A. D. Nutt of Rugli, Mt. Hagen, T.N.G., by the use of the scale reproduced here.

Mr Nutt explains his idea in the following letter:

"Regarding the Distortion Meter in the July issue, might I suggest that the attenuator be calibrated in 10db steps, making the distortion ranges 100 p.c. (0dB), 30 p.c. (—10dB), 10 p.c. (—20dB), 3 p.c. (—30dB) and 1 p.c. (—40dB). The 30 p.c. and 3 p.c. ranges, of course, would be actually 31.6 p.c. and 3.16 p.c. respectively, the scale being shortened in a similar manner to that of the VTVM.

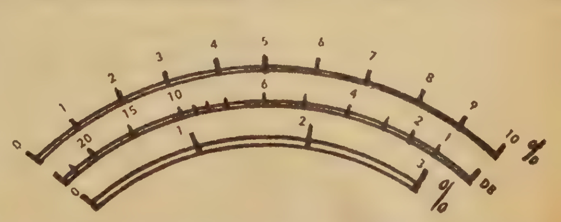
"This would then enable the instrument to be utilised for noise measurements and the level read directly in dB below the reference level.

"I have just completed some experiments along this line and intend incorporating the aforementioned ranges in my own instrument, calibrating my own meter scale."



Above: The input divider for the suggested new calibration.

Right: The dial calibration should be checked accurately with the aid of other instruments but this drawing gives an idea of how it will finally look.



Approx. calibrations

For New Zealand readers . . .

IRONCORE COMPONENTS

for RTV & H 1959 TV RECEIVER

- ☆ **POWER TRANSFORMER** Cat. R 98
- ☆ **FILTER CHOKE** Cat C 36
- ☆ **AUDIO O.P.T.** 7000 Ohm Prim } 2 ohm V.C.—S107 / 3 ohm V.C.—S34 / 3.5 ohm V.C.—S70
- ☆ **VERTICAL O.P.T.** To match M.S.P. Yoke Y 110D1. Cat. T 1
- ☆ **VERTICAL BLOCKING OSC. TRANSFORMER** Cat T 2

BEACON RADIO LTD.

CNR. BROWN & FITZROY STREETS, PONSONBY, AUCKLAND, N.Z.
P.O. Box 2757, Phones: 14-704 and 13-390

The Only High Precision Pick-up Arm Designed Especially for STEREO

Ortofon SSM 212

- *Calibrated counter-weight adjustment which includes pre-set adjustment for initially balancing for any type or make of cartridge.*
- *Unique rubber mounting of counter-weight portion to eliminate arm resonance.*

Used with the Ortofon type G shell, the SSM 212 is the ideal unit for any stereo pickup movement.
The SSM 212 is available complete with the new Ortofon stereo pickup cartridge or with an empty shell which will take the standard cartridges of other makes.

For demonstration and full technical details, contact your local distributor.

Australian National Distributors: SIMON GRAY PTY. LTD., 28 Elizabeth Street, Melbourne. Telephones MF8211, MF8166.

Here's your answer, Tom!

Once again Tom has put pen to paper in an effort to satisfy his craving for knowledge. The queries are typical of those that bother beginners and we hope that a number of your pet problems are included in our selection for this month.

WHAT is the purpose of screening or shielding, and how does it function?

Screening or shielding, Tom, normally involves the use of a metal can or a partition between components in a receiver or amplifier, to minimise coupling between them, due to electrostatic or electromagnetic fields.

An electrostatic (or just "electric") field is essentially a matter of capacitance, whereby signal energy on one component or wire can be transferred to another component or wire, often with undesirable effects. Instability in a radio receiver is one such possible effect: hum in an audio amplifier is another, though both can result from other causes.

Electrostatic coupling can be minimised or eliminated by placing a metal can around one or both of the relevant components, or a partition between them, thereby restricting the electrostatic field.

To be effective, the can or partition must be reasonably conductive, quite thin gauge metal being effective, or even wire gauze. However, it must be at "earth" potential, as far as the signal frequency is concerned, so that it cannot transfer the signal from one component to the other.

In most cases, shield cans or partitions are simply connected to the chassis or earth system of the equipment. However, in special cases, the shield can be at a DC potential different from chassis, provided it is bypassed to chassis with a capacitor.

An example of this latter technique is the screen grid inside a pentode valve. This has to be operated at a positive potential, so as not to prevent the flow of electrons from cathode to plate. However, by making sure that it is bypassed to chassis, as is normally done with a pentode valve, it still acts as an effective shield between grid and plate.

Shielding against electromagnetic effects, as the term implies, is aimed at preventing the coupling of energy from one component to another by electromagnetic lines of force.

When current flows through a conductor, it produces a magnetic field around that conductor.

When a conductor is wound up to form a coil or choke or transformer, the magnetic field is augmented and lines of force from it may cut across adjacent conductors or components and induce current and voltage in them.

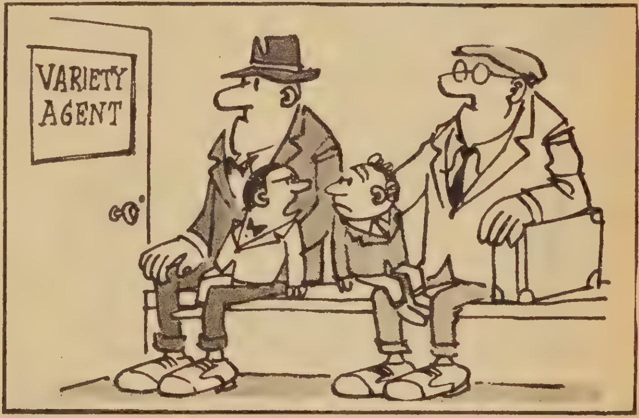
Magnetic fields are more difficult to confine than electrostatic fields, particularly at very low frequencies as, for example, audio or power frequencies.

To be effective, shield cans or partitions have to exhibit a high permeability to the lines of force, so that they flow through the shield rather than through adjacent space. This normally involves the use of high permeability alloys, which can be quite expensive, or very considerable thicknesses of ordinary ferro-magnetic materials.

Magnetic shielding may be used around a component to confine the initial field or it may be used to prevent entry of stray magnetic fields, where such is important. For example, microphone transformers are commonly enclosed in multiple magnetic shields to prevent hum pickup from adjacent power transformers, etc.

At higher frequencies, as in the RF spectrum, magnetic shielding can be achieved with non-ferrous materials, aluminium being the most commonly used, as for coil cans.

In such cases, cans or partitions serve both as electromagnetic and electrostatic shields.



"Come outside and repeat that, you . . .!"

* * *

I want to use a 6 volt soldering iron from the AC mains for wireless work. How can I do this?

It should be possible to power your iron from the AC mains but, it may not be economical. Direct connection of the iron to the mains is out of the question because it would most certainly destroy the iron, due to the very low resistance of the element.

To enable you to operate the iron from the mains, Tom, it will be necessary to interpose a transformer to step the mains down to a suitable voltage.

The transformer rating will be governed by the wattage rating of your iron and, as you have not specified this, we can only generalise.

Assuming that the iron is rated at 40 watts, not an uncommon figure, then its current consumption at 6 volts will be approximately 6.5 amps. We arrived at the figure by using a variation of the formula: Watts equals Volts multiplied by Amps.

Irons with higher wattage rating will require a heavier transformer and vice versa. Considering the likely cost of a transformer with, say a 10-amp rating, not to speak of its availability, it may be better to purchase a new iron with the appropriate voltage rating.

* * *

What is meant by after-glow in cathode ray tubes? Is it the same as persistence? Why are some long and others short?

After-glow and persistence are both terms which refer to screen characteristics of cathode-ray tubes and, in particular, to the luminosity which persists after the electron beam has been interrupted.

The impact of electrons, striking the substance on the tube screen, causes the particles in the screen to fluoresce. Surprisingly, perhaps, the screen continues to glow for a brief period after the electron beam is interrupted. The period of after-glow varies from a few milliseconds to several seconds, according to the substance used for the screen and the number and speed of the electrons striking it.

Various substances are used for coating tube screens and are termed "phosphors."

The degree of the after-glow in a cathode ray tube is a very important feature. In radar PPI indicator tubes, for example, a long after-glow is desirable so that the position of an object will remain visible during the whole of the time taken for the trace to rotate around the tube face.

In other cases, such as the normal

FLASHERS

"PAYNECO"

NEW TYPE D LAMPHOLDER FLASHER

TYPE B

TYPE C

TYPE SF

TYPE 1
TEMPORARY USE ONLY

TRAFFIC WARNING FLASHER

LIGHTHOUSE BEACON FLASHER

ADVERTISING SIGNS
TRAFFIC LIGHTS
CAR SIGNALS
INDUSTRIAL WARNING
DISPLAYS

D—25-100W, 230v. AC/DC. APPROX 12 FPM CONT. RATING.
B—25-100W, 230v. AC/DC. APPROX. 12 FPM CONT. RATING.
C—60-500W, 230v. AC/DC. APPROX. 12 FPM ALTERNATING CONT. RATING.
SF—5 AMP, 6, 12, 24, 48v. AC/DC. INSTANT START 40 OR 80 FPM CONT. RATING.
1—25-100W, 230v. AC/DC. APPROX. 12 FPM INTERMITTENT RATING.

TRAFFIC WARNING FLASHER, 10A SP OR DP CONT. RATING 60 FPM.
LIGHTHOUSE BEACON, LAMPCHASERS,
MOTORISED UNITS, ETC., TO ORDER.

QLD. H. MARTIN
Wilson House, Charlotte St.,
Brisbane. B 1785-6.

W.A. SALES PTY. LTD.
1142 Hay St.,
Perth. BA 9781

RONALD J. T. PAYNE PTY. LTD
385 BRIDGE ROAD, RICHMOND, VIC.
JB 1416.

I use the solder leading TV and radio manufacturers use

ERSIN Multicore

5 CORE SOLDER

PACKED IN A CONVENIENT DISPENSER PACK

I know Multicore. I know leading radio and television manufacturers in most countries of the world, including U.A.S. use it exclusively. For Multicore is the only solder with more than one core of flux built right into the solder itself. Multicore has five!
This is complete protection against dry joints . . . and as Multicore uses only virgin metals, every inch is top quality.
I like the dispenser pack — the wire draws from the top without twisting or damage.
I like the fact that you use far less Multicore on every joint. Top quality, convenient, economical and now made right here in a modern Australian plant. What more could you want?

HOW TO USE MULTICORE

Apply Ersin Multicore Solder simultaneously with the iron or other means of heat to the clean components to be soldered. No additional flux is required. Only apply solder direct to the iron for tinning. Do not carry solder to the joint on the iron.

PULL AS REQUIRED
SIZE
DIAM
18 S.W.G.
ERSIN
Multicore
FIVE CORE SOLDER
HIGH TIN TELEVISION & RADIO QUALITY
60/40
CONTAINS 5 CORES OF NON-CORROSIVE FLUX
MADE IN AUSTRALIA

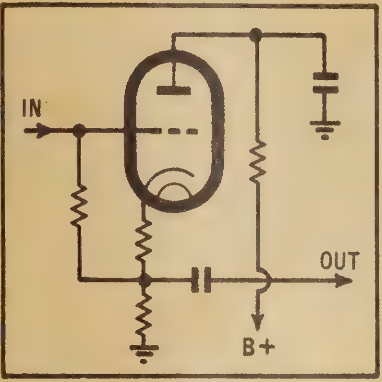
MULTICORE SOLDERS (AUST.) PTY. LIMITED
43-51 NELSON STREET, ANNANDALE, N.S.W. LA 3666

oscilloscope, a short after-glow is desirable.

In television, a very small amount of after-glow is desirable mainly to prevent flicker in the highly illuminated portions, although it should not be long enough to cause a "defocusing" effect on a moving picture.

What is a "back emf"?

A "back-electromotive force," Tom, is a phenomenon which occurs in certain radio and electrical components and which opposes the normal flow of alternating or changing current through them.



Basic circuit of a cathode follower amplifier stage.

It occurs, in fact, in all circuits and components containing inductance as, for example, coils, chokes, transformers, motors, etc.

If the current, at a particular instant, is tending to build from zero, it produces an expanding magnetic field. This field, in turn, acting on the same conductors as are carrying the original current, induces in them one of opposite polarity.

This induced current and voltage, which opposes the original current and voltage, is known as the "back emf."

In a filter choke, the current tends to rise over that portion of the input cycle when the rectifiers are delivering higher voltage. But the back emf effect opposes the rise in current. Similarly, during that portion of the input cycle when the current tends to fall, the choke opposes this fall and tends to maintain something approaching the original current.

Hence its filtering effect.

In an electric motor, the input voltage does not produce current in simple proportion to the DC resistance of the motor windings. If it did, the motor would overheat and burn out.

Instead, as the motor rotates, the rise and fall of current through the various windings induces back emf which opposes the flow of "driving" current and effectively reduces its amplitude.

Thus, the total effective current through the windings is the initial current minus the induced current.

* * *

What is a cathode follower?

A cathode follower, Tom, is a valve and associated circuitry, so arranged that the output signal is delivered from the cathode instead of from the anode.

The circuit of a typical cathode follower is reproduced. The lower resistor in the cathode circuit and the series capacitor are the coupling components, the latter being the equivalent of the coupling capacitor in a normal plate loaded stage. The components in the anode circuit are purely for decoupling purposes.

The cathode follower has a number of special characteristics and advantages for certain applications. Its output voltage is in phase with the input, unlike the normal amplifying valve with the output taken from the anode, where the voltage is out-of-phase.

A cathode follower gives no voltage gain; in fact, it gives a loss. However, it has a considerable negative feedback and has a very low output impedance. The latter feature makes the cathode follower valuable for various special tasks, such as matching high impedance signal sources to a low impedance line or circuit, without the assistance of a matching transformer.

* * *

What is a cadmium cell?

A cadmium cell, Tom, is a voltaic cell with a very constant emf. It is, therefore, often used as a voltage standard.

The cadmium cell delivers a voltage of 1.0183 volts at a temperature of 20 degrees Centigrade and may be relied upon to an accuracy of one part in a thousand.

This cell is a primary cell and cannot be recharged like the secondary cell, its basic principles of operation being like that of any other primary cells. The basic constituents are the two electrodes of dissimilar conductive materials and an electrolyte.

When a circuit is made externally and a current passes through the cell, gas is liberated at the positive electrode and this, in reducing the effective area of the electrode, increases the effective resistance of the cell and thus limits the current that can be drawn from the cell.

This process is called polarization and a depolarizer is used to absorb the gas and so reduce the internal resistance of the cell. All primary cells produce polarization and so have a considerable internal resistance, limiting the current that may be drawn from them.

The cadmium cell contains a cadmium anode and a mercury cathode in a cadmium-sulphate solution. Mercury sulphate acts as the depolarizer.

When used as a standard, this cell usually has a series resistance of several thousand ohms connected to one of its terminals so that it will not be damaged by accidental short-circuit.

* * *

Is a caesium cell some kind of battery?

No, Tom, the caesium cell is not a battery. It is a photocell in which the cathode is a very thin layer of caesium deposited on silver. It emits electrons when activated by light.

Caesium is more sensitive to light than any of the other metals which exhibit photo-electric properties and is, therefore, the most widely used substance in modern photocells. The caesium cell has high sensitivity at the red end of the light spectrum and is consequently best suited for use with artificial lighting.

* * *

What is a quasi-optical wave?

A quasi-optical wave, Tom, is an electromagnetic wave of very short length, whose behaviour is governed by the same laws as light waves. Waves having lengths of 1 to 10 millimetres are generally regarded as quasi-optical.

The RADIOMASTER
RADIOGRAM CHASSIS . . .
A great performer on Radio and Records

HIFI MODEL E22 reproduces perfect high treble notes and bass notes without "drumming" or distortion—brings recorded sound to your home as near as possible to the original. A high gain R.F. stage ensures satisfactory long-distance radio reception.

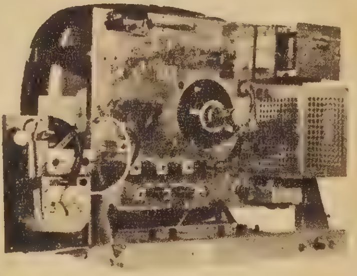
8 valves, £41/15/-

STEREO MODEL S77 gives glorious three dimensional sound that comes from everywhere in the room. Features include dual treble, bass and volume controls, also balance control. Broadcast and short-wave radio. Seven valves. Single chassis. Two speakers.

PRICE, £36/15/-

Packing included. Freight extra.

TELEVISION CHASSIS



With noise gate and A.G.C.
Ideal for fringe areas.

21in models from £108

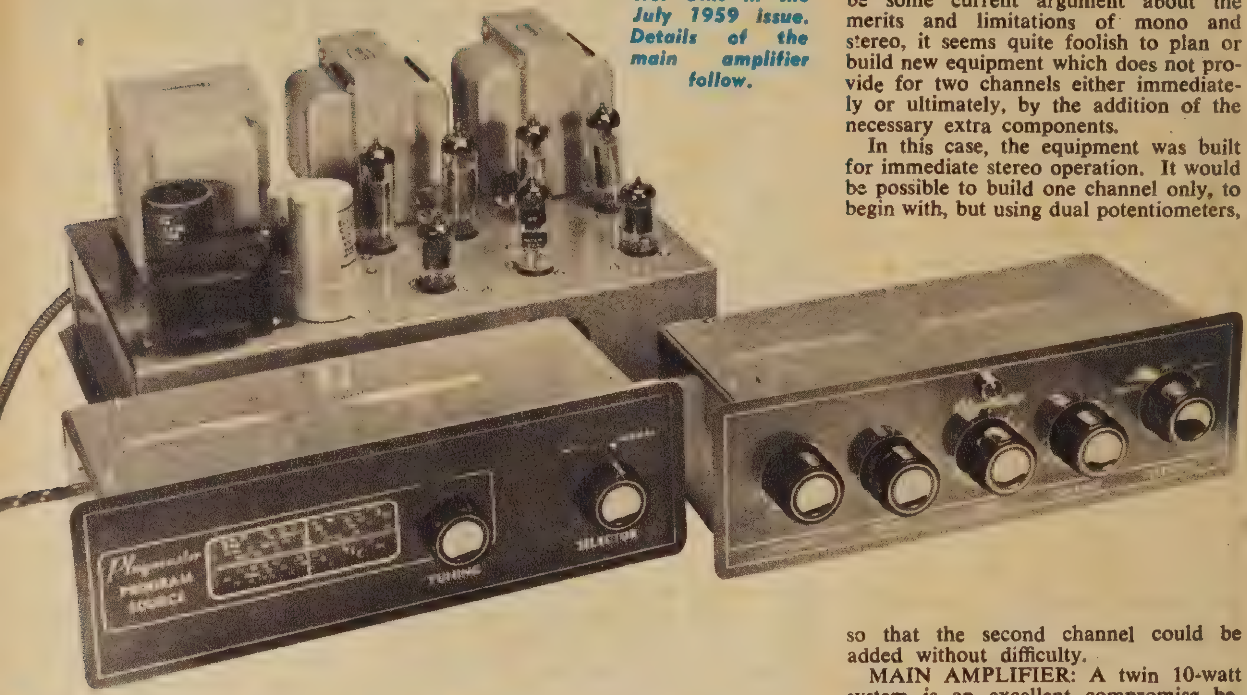
RADIOGRAM — TV & STEREO CABINETS

Many popular designs are available, including combination Radio-TV-gram. All wanted colours, first-class finish.
New models for Hi-Fi or Stereo incorporate speaker enclosures. TV cabinets can be supplied complete with brackets and straps for picture tube mounting.

ALL TYPES OF FOUR-SPEED & STEREO RADIOGRAM UNITS

WRITE FOR CATALOGUE.

H. B. RADIO PRODUCTS
103-105 Catherine Street
Leichhardt, SYDNEY
Telephone LM5580.



The tuner was described last month, the Control Unit in the July 1959 issue. Details of the main amplifier follow.

A Typical Complete Playmaster System

The combination of Playmaster units pictured above should be just about ideal for the many enthusiasts who want high quality equipment for the least possible outlay. Housed in a small cabinet and feeding seperate good quality speakers, it is capable of outstanding performance.

by Neville Williams

OUR prime purpose in presenting the units as a group is to give a possible ead to the many readers who write to us for advice along these lines. They point out that a large number of Playmaster units have been described over the years and it is difficult to decide which particular ones are most likely to suit them.

Actually, there is no standard answer o such a question, because the final choice is likely to be influenced by cost, by personal preferences and the natural desire, in many cases, to adapt or convert existing equipment.

Be that as it may, the equipment pictured above was assembled by one of our own staff members for his own use and, seeing it, we couldn't help wondering, "Who would want anything better?"

Naturally, there are some folk who will immediately retort, "I would," but they are the ones whose cheque books are equal to the challenge of expensive magnetic pickups, multiple speakers and enclosures and, of course, nothing less than a twin 20-watt amplifier!

Most of us have to be content, however, with more modest ambitions.

However, as we said earlier, the gear pictured above was put together by a member of our staff for his own use and the thinking behind it might be summarised as follows:

STEREO OR NOT? While there may be some current argument about the merits and limitations of mono and stereo, it seems quite foolish to plan or build new equipment which does not provide for two channels either immediately or ultimately, by the addition of the necessary extra components.

In this case, the equipment was built for immediate stereo operation. It would be possible to build one channel only, to begin with, but using dual potentiometers, so that the second channel could be added without difficulty.

MAIN AMPLIFIER: A twin 10-watt system is an excellent compromise between the reservation that "five watts may not be enough" and "20 to 30 watts is far too big and expensive."

The main amplifier illustrated above is interesting in another respect, but more of that anon.

PICKUP: Not having the benefits, economically, of mass production, stereo magnetic pickups are generally in the scarce, formative and expensive stage. Crystal pickups are better established and cheaper and have been refined to the point where they are capable of excellent reproduction, even if they are not quite as good as the top magnetics.

Also, crystal pickups are not prone to induction pickup from motor windings, which can be a problem with magnetics.

This influences the next item.

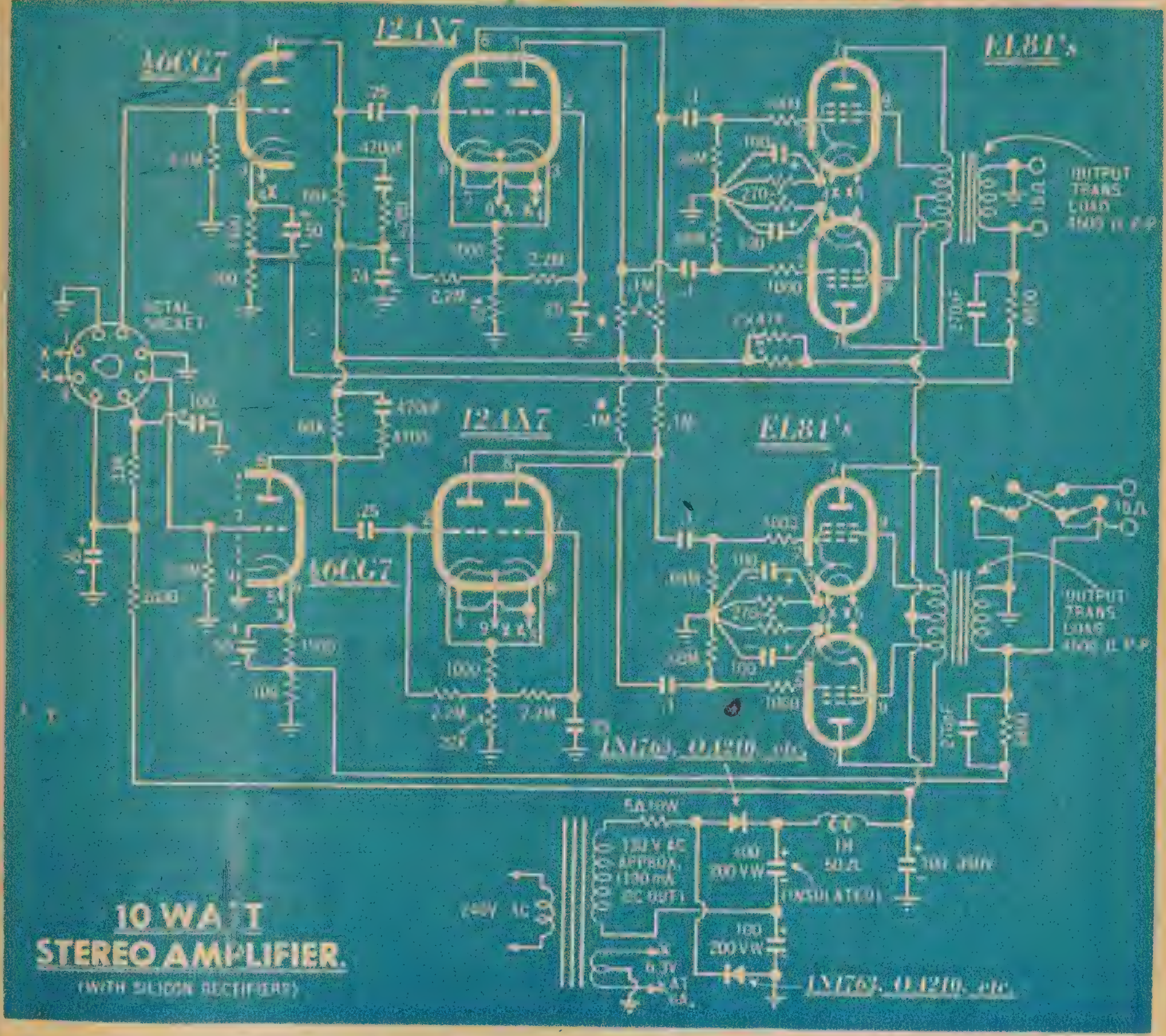
CONTROL UNIT: If a crystal pickup is assumed, noise, hum and instability problems are minimised, because low-level preamplification and frequency correction is rendered unnecessary.

It is possible to build the appropriate switching and control facilities into the main amplifier chassis, which can then be "dressed up" so that it strictly does not have to be housed inside a cabinet.

The alternative is to build a separate but internally simple control unit, as illustrated. It has the definite advantage that it can be expanded at some later date to accept the output from a magnetic pickup, should one ever be substituted. This would not normally be true of a single-unit amplifier.

TUNER: In most cases, the ability to

10W. STEREO AMP. WITH SILICON RECTIFIERS



The circuit above follows closely the original twin 10-watt amplifier described in January 1959 but uses a silicon diode type power supply, with a considerable saving in the size of the power transformer.

tune radio programs will be subsidiary to record playing facilities. Also the question of broadcast, shortwave, F.M., etc., arises, as discussed last month.

The tuner around which these discussions centred is the one illustrated.

So much for the basic amplifier gear. Its ultimate performance will depend a great deal on the associated pickup, motor, loudspeakers and baffle systems. What one pays for these items also determines very largely the overall cost of the complete installation.

While it would be very nice to be able to nominate certain ancillary items which combined the highest possible quality with a very low price, it is doubtful whether such items really exist. In general, quality costs money, and our impressions might be set down as follows:

CRYSTAL PICKUPS: While there may be differences, the preferred models sold by the major manufacturers are comparable in performance. There is no need, with the Playmaster equipment described above, to buy "high output" cartridges, in which some compromise may have been necessary with distortion level and frequency response.

MOTOR: Ordinary "standard" motors and record changers made by the major manufacturers are of comparable quality. They may vary from unit to unit, but are seldom completely adequate for a wide-range system, because of residual rumble and possibly speed variation.

SPECIAL TURNTABLES

One or other of the more expensive specialised turntables is desirable, any one of them being preferable to a standard cheaper type, but the quality, thereafter, largely follows the price.

LOUDSPEAKERS: Wide variations occur between different types of loudspeaker and individual listeners may, from custom, prefer the "sound" of one type to that of another. However, the overall merit of loudspeakers follows the price quite closely and it is a wise plan to purchase the best that can be afforded, advertising claims notwithstanding.

BAFFLE SYSTEM: The tendency with stereo, largely born of necessity, is to use smaller enclosures and sometimes smaller speakers than was common with mono systems. Some of the smaller cabinet/speaker combinations do, in fact, sound quite well, but, speaking generally, it is wise to use the largest and most heavily built enclosures that can reasonably be placed in the listening room.

Though usually not so decorative, separate enclosures, which can be placed in optimum positions, are to be preferred to large single cabinets, wherein the speaker distance cannot be varied and in which the speakers are often too close, anyway.

Now for a few words about the basic amplifier, whose circuit is shown above.

When this amplifier was being contem-

MiL's NEWEST!

Stereo
Eight-Eight

STEREOPHONIC

BALANCE CONTROL
Has electronic visual balance indicator to eliminate the guesswork in balancing your amplifiers.

8/8 AMPLIFIER

IN MATCHING CABINET BY FLER

For full specification and test data including three laboratory graphs write to:

THE SERVO MECHANISM CO.
505-511 Lygon Street
East Brunswick

Designed in Servo's own laboratories. Functional design includes layout, controls, feed-back circuit and output transformer. Solid timber cabinet is manufactured to exacting MIL specifications by FLER.

CONTROLS:

Selector switch gives you Mono-Radio, Stereo-Radio, Mono-Gram, Stereo-Gram, Stereo-Gram Reverse.
Volume Control
Balance Control with indicators
Treble Control and
Bass Control (For each channel coupled and matched)

MANUFACTURED BY:

THE SERVO MECHANISM CO.

A DIVISION OF MEDDING INDUSTRIES LTD.
505 Lygon Street, EAST BRUNSWICK

FACTORY REPRESENTATIVES:

NEW SOUTH WALES: R. W. Winning Pty. Ltd.
225 Clarence St., SYDNEY, N.S.W. BX 2111.

SOUTH AUST.: Woollard & Crabbe Ltd.
176 Wright St., Adelaide, S.A. LA 4713

plated, we wondered about the possible use of silicon rectifiers in place of the usual thermionic type.

The advantage of the silicon rectifiers is that they allow a much smaller and cheaper power transformer to be used, for the same DC output. This stems from three facts:

(1) There is a direct saving of the 10 to 15 watts required to operate the rectifier heater.

(2) There is virtually no voltage drop across the rectifiers, representing wasted wattage, which the transformer has to supply in the first instance.

(3) By using a full-wave voltage-doubling rectifier, only a simple untapped H.T. secondary is required, further reducing the bulk of the winding and the relevant insulation.

When we "tried out" the idea on one of the local manufacturers, they responded enthusiastically, because it tied in with their plan to release a competitively priced but good quality kit of transformers for the twin 10-watt stereo amplifier.

POWER TRANSFORMER

If the idea takes on, other manufacturers will doubtless follow suit.

More or less, as we expected, use of silicon rectifiers made possible a considerable reduction in the size of the power transformer so that, even though it is providing 320 odd volts of DC at 190 odd milliamps, it is on the same core as the output transformers and looks more like a conventional 100-milliamp type.

The saving is offset somewhat by a slightly more costly combination of electrolytics, and the fact that two silicon diodes cost a little more than a rectifier valve and socket. However, against this, is the fact that the voltage regulation appears to be rather better and the diodes should have unlimited life.

As in television receivers, we expect to see silicon diodes gradually replace thermionic rectifiers in all large amplifier systems.

The output valves should operate with a voltage of 300 between the high tension line and cathodes, which means 311 volts HT to earth, with a normal mains voltage of 240.

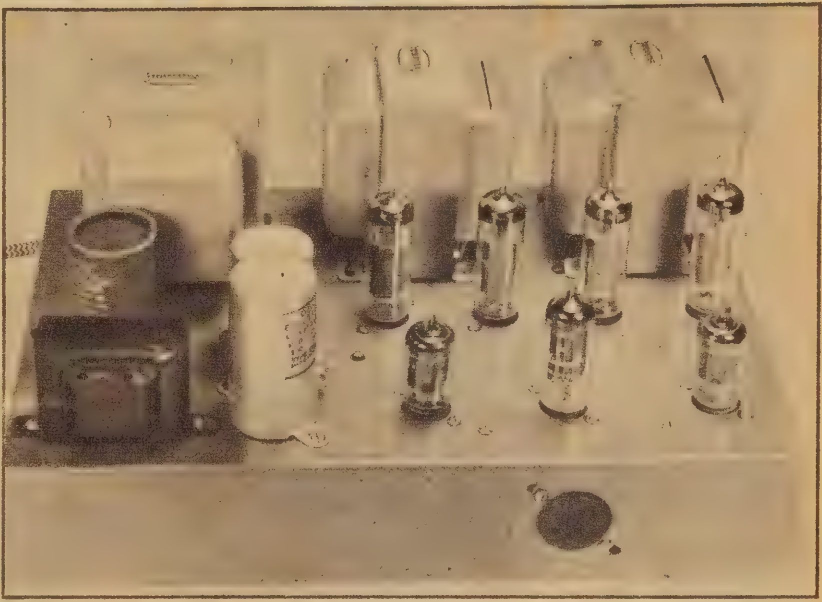
With the tuner in circuit, something very close to this figure should be obtained automatically from the circuit as shown, though the exact value will depend on actual drain, transformer details and the value of the two input capacitors.

For this reason, the 130 volt rating on the transformer secondary should be regarded as approximate only. Individual manufacturers may see fit to vary the figure by a few volts in the light of their own tests.

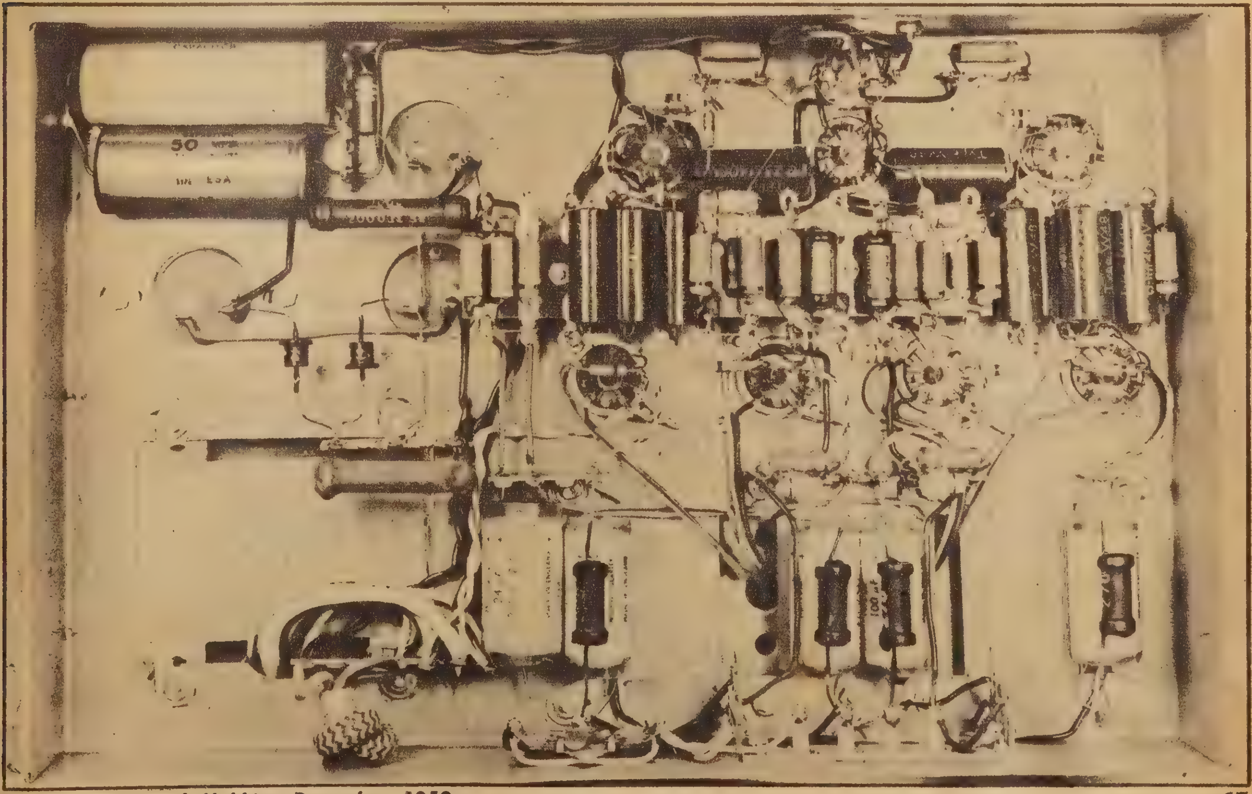
If measurement establishes that the

(Continued on Page 127)

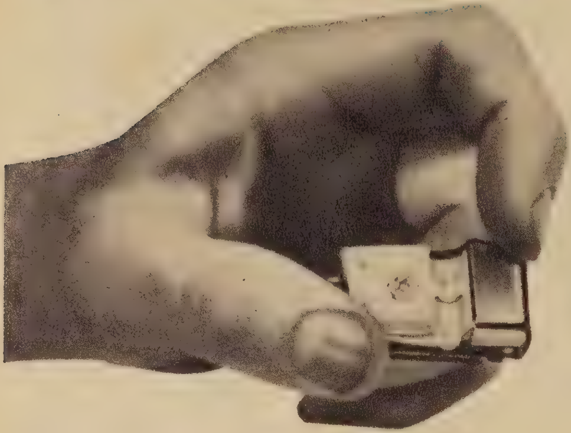
TOP & UNDER VIEWS OF CHASSIS



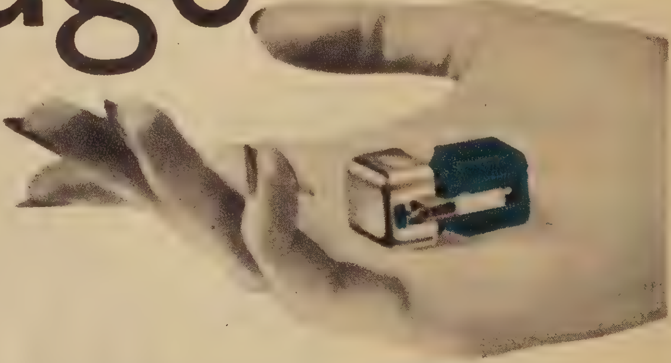
These two views of the chassis show the wiring and construction fairly clearly. The component panel can be wired exactly as shown for the previous version on page 35 of the January 1959 issue.



the all-new VR-22 stereo cartridge



VR-225 .5 mil diamond stylus. For professional-type tone arms,



VR-227 .7 mil diamond stylus. For record changer or turntable,

Now, outstanding in all four critical areas of stereo cartridge performance—**Compliance**—Tracks precisely, not a trace of stiffness. **Channel Separation**—Up to 30 db for maximum stereo effect. Nothing higher on the market! **Response**—Smooth and flat for superior sound from 20 to 20,000 cycles (VR-225), 20 to 17,000 cycles (VR-227). **Virtually hum-free**—triple shielded against stray currents. **This is our masterpiece. We urge you to hear it.**

GENERAL ELECTRIC

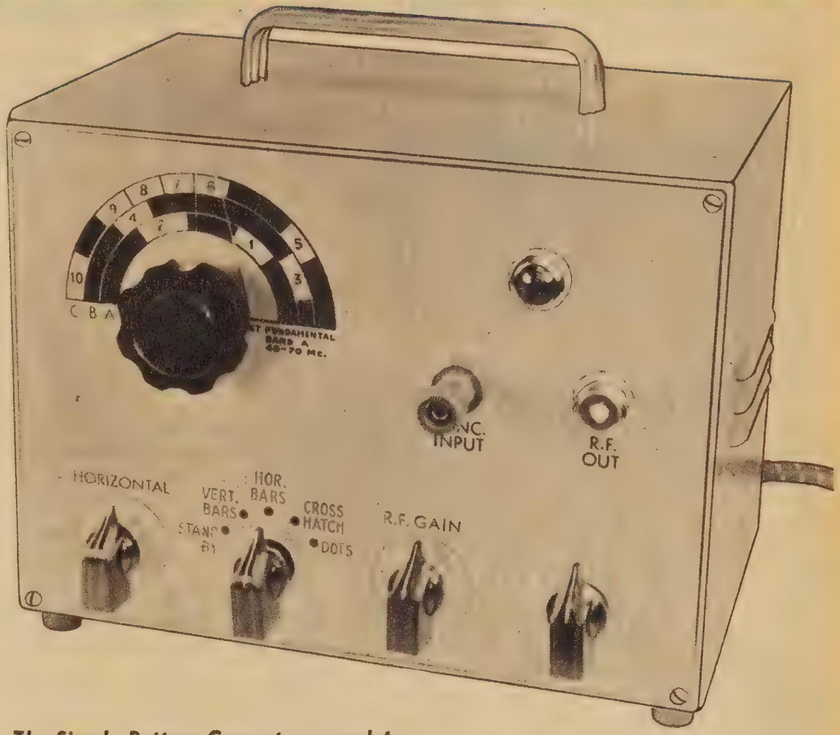
AVAILABLE THROUGHOUT
AUSTRALIA FROM . . .

Fidelity AE
Audio Engineers PTY. LTD.

NOW AVAILABLE AT
YOUR LOCAL DEALER

PANEL FOR PATTERN GENERATOR

Here are a few additional notes on the Simple TV Pattern Generator described in the January, 1958 issue. They discuss details of an etched panel recently made available and modifications to the fundamental frequency coverage to suit this.



The Simple Pattern Generator, complete with etched panel. Type matter is in different colours.

AT the time this instrument was described we expressed the hope that some of our advertisers might make available an etched panel to suit it, thus giving the instrument a more professional appearance and making it unnecessary to rely on memory for the various control functions.

Unfortunately, no one offered to undertake this until recently, when R. H. Oxford and Sons Pty. Ltd. asked for details in order that they might market such a panel. We were quite happy to supply these, but setting out a suitable scale for the RF tuning control presented a few minor problems and, to make things simpler and more logical, it appeared worthwhile to modify the unit slightly.

TUNING RANGE

As mentioned in the original article, the tuning range is intended to cover only the lower channels on the fundamental, the higher channels being covered by harmonics. While no band switching is involved it is helpful to have calibration markings for all the channels so that the risk of working with unsuitable input is minimised.

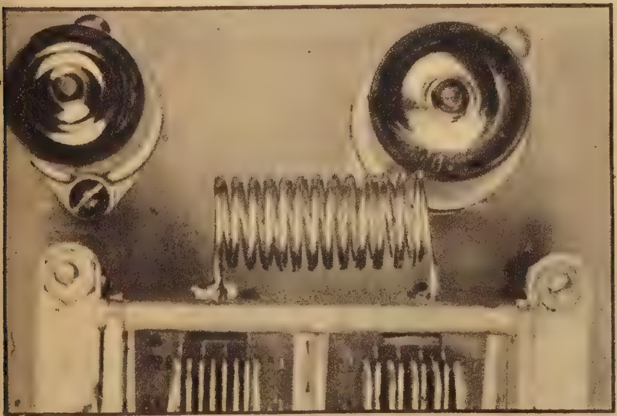
About the easiest way to do this is to provide several arcs on the scale, calibrated exactly as if separate ranges were used. In practice this works very well, and allows the correct fundamental to be chosen quickly and easily.

However, when we came to prepare the scale we realised that our original coil, while capable of putting a signal into every channel, would not produce the most desirable distribution of channel markings. As a result, we found it necessary to revise the fundamental coverage slightly.

This now ranges from 40 Mc to 70 Mc; adequate for channels 1 and 2 but, as will be seen, fairly critical in regard to the higher ranges. The lower limit just covers channel 3 (82.25) on the second harmonic, along with channel 4 (133.25) toward the high end, but with plenty to spare. The third harmonic covers channel 5 (140.25) to channel 10 (210.25), the latter being just within range of the top end of the fundamental.

The coil is wound from 18 gauge tinned copper wire on a 3/8in diameter former. It has 13 turns and is approximately 1in long. This fits in nicely with the spacing between the gang terminals.

The range may be checked most easily with a grid dip oscillator as a first step, then on a TV set for final pruning to make it fit the calibrated scale. The generator should be set to give the highest contrast pattern (white bars on a black background) for each channel. However, it should be remembered that unused channels in a set may not be correctly adjusted and this fact taken into account in the event that one or two markings do not line up exactly.



A slight modification is required to the coil to secure the desired coverage. See text for details.

MODIFIED PANEL

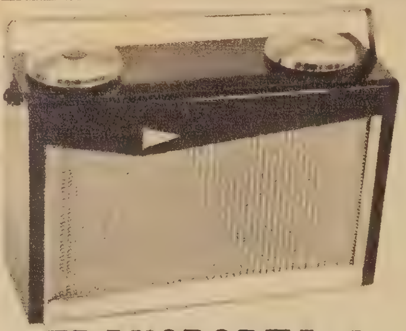
The panel is made from a substantial gauge of aluminium and may, in most cases, replace the original steel panel supplied with the box. In making this change-over we took the opportunity to modify the panel layout slightly in the interest of appearance. The main change concerns the placement of the synch input terminal, RF output socket, and indicator lamp bezel. This is clearly visible in the photograph.

Incidentally, a few of the earlier panels were punched with slightly oversize holes for the RF output socket. To overcome this the makers will supply a pair of aluminium washers which will permit fitting the conventional Acme or Amphenol type socket.

The holes for the synch input terminal and the indicator bezel have been deliberately left on the small side. We feel this is safest, since readers may want to use a terminal or bezel other than the type we used. In such cases, it is always easier to make a hole bigger than smaller.

(Note. A minor error occurred in the original circuit. A 47K resistor should be added between the HT line and the moving arm of switch Slb. This concerns the "White Dots" position only.)

MAKING A TRANSISTOR PORTABLE FOR THE HOLIDAYS?



TRANSPORTA 4

Complete Kit of Parts for Transporta Four as Featured in October Radio & Hobbies, including Cabinet as used with the Transporta

£16/17/6
PLUS POSTAGE
Less Cabinet £14/7/6

Most parts used in the Transporta Four can be used for the Transporta Seven should a larger set be required at a later date.

COMPLETE KIT OF PARTS for the TRANSPORTA SEVEN

£26/17/6 SET WIRED AND TESTED £2/10/- EXTRA

Complete kit of parts for the Transporta 7 as featured in Radio & Hobbies, including 7 S.T.C. Transistors, Printed Circuit Boards, Coil Kit, Rola 5F Speaker and Transformers and all necessary parts to complete this set including attractive and durable two-tone cabinet with gold trim.

Fitted with special aerial coil and plug to connect to your car aerial or external aerial making it an ideal car set or for use in the country.

POSTAGE AND PACKING EXTRA on transistor 4 or 7 sets.	N.S.W. 15/-. INTERSTATE 22/-.

NEW 6V. RECORD PLAYER £7/15/-

These new 4-speed Record Players are supplied with turnover crystal pick-up and sapphire needles, and are suitable for use with the above or any transistor radio.

Postage and packing extra. N.S.W. 10/; Interstate 15/.

TAPE-RECORDER MOTORS

New Colaro Tape Recorder Motors. 240 volt, A.C. Adaptable for many uses.

37/6 **Post extra.**

CONDENSER SPECIALS

Boxes of 100 new ceramic, mica, paper and electrolytic condensers in values ranging from 50pf mica to 5 400v paper. Values include .0001, .00025, .00075, .01, .02, .05, 1. Also 500 mfd/12v., 10 mfd/40v., 16 mfd/350v., electrolytics.

25/- **per 100.**
Post Extra: N.S.W., 2/6: Int., 3/6.

CONDENSER SPECIALS

100 new mica paper and ceramic condensers, mixed values.

15/- **Post 2/.**

NEW IR.C. RESISTORS

I.R.C. carbon resistors, ½, 1 and 2 watt, in values 5 ohms to 5 meg., including many popular sizes. 3T, 15T, 20T, 50T, 100T, 250T, 500T, etc.

(Standard resistor colour code supplied.)

100 for 25/-. **Plus 1/6 postage.**

NEW METER RECTIFIERS

Westinghouse 1 mA rectifiers, 15/.

ELECTROLYTIC CONDENSERS

New Dubilier pigtail condensers.

8mfd 600V	3/9
16mfd 600V	5/9

Post Extra

DYNAMIC SPEAKERS

New 7in Dynamic Speakers.
1500 ohm. Field, 25/.
5T or 7T trans., 10/- extra.
Plus postage.

NEW 4in PER-MAG SPEAKERS

5T or 7T Trans.

25/-
Post and Packing, 3/6.

HIGH IMPEDENCE HEADPHONES.

NEW 27/6.
Post 2/6.

STANDARD INTERMEDIATE FREQUENCY TRANSFORMERS

455Kc, 1¼in square can. Slug tune.
4/9 post extra.

NEW POWER TRANSFORMERS

60mA prim.: 240v with 230v tapping. Sec. 285. x 285 with 6.3v filament winding 60mA.

25/- **Plus postage, N.S.W. 3/6, Int., 5/3.**

NEW MIDGET POWER TRANS.

40mA prim., 250v. Sec. 225 x 225 with 6.3v Fil. Winding Upright or Flat Mounting. Size 2in x 2½in.

25/- **2/6 Postage, N.S.W., Interstate, 4/6.**

30mA 240v Prim. 150 x. 150v. Sec. with 6.3 v Fil. Winding.

22/6 **Postage: N.S.W., 2/6 Interstate, 3/6.**

MICA CONDENSERS

Standard Mica Condensers, small current types .00003 and .005, including most wanted values.

10/- **Postage 1/6. per 100.**

CARBON RESISTORS

New carbon resistors, mixed values. Well-known make. **10/ per 100. Post free.**

NEW POTENTIOMETERS

with SWITCH STANDARD SPINDLE	WITH SWITCH SHORT SPINDLE	LESS SWITCH STANDARD SPINDLE	LESS SWITCH SHORT SPINDLE
25,000 ohms 100,000 ohms 500,000 ohms 1 meg. ohm	100,000 ohms. 500,000 ohms.	100,000 ohms. 500,000 ohms.	50,000 ohms. 100,000 ohms. 500,000 ohms.
4/6 ea. 42/ doz.	2/6 ea. 24/ doz.	3/6 ea. 33/- doz.	1/9 ea. 16/ doz.

500,000 ohm pots can be supplied tapped at 40,000 if required, post extra.

NATIONAL RADIO SUPPLIES

332 PARRAMATTA ROAD, STANMORE, N.S.W. Phone LM7398

SPECIAL PURCHASES!

New 5 Valve Dual - Wave Radiogram Chassis

THESE NEW DUAL WAVE RADIOGRAM CHASSIS MADE BY LEADING MANUFACTURER ARE EQUIPPED WITH LATEST MINIATURE VALVES AND SUPPLIED WITH 12in ROLA SPEAKER. PACKING 10/- EXTRA.

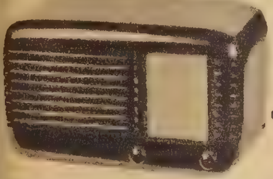
£16/15/-
F.O.R.

NEW 4 SPEED RECORD CHANGERS

THESE NEW 4 SPEED RECORD CHANGERS ARE EQUIPPED WITH HIGH FIDELITY CRYSTAL PICK-UP AND SAPPHIRE NEEDLES. CAN ALSO BE USED AS A MANUAL PLAYER.
SUITABLE FOR USE WITH ABOVE RADIOGRAM CHASSIS. F.O.R.

£10/15/-

MAKE UP THE "LITTLE GENERAL"



£12/17/6

Complete kit of parts for the 1957 "Little General" as featured in R. and H., including attractive bakelite cabinet with slide dial. Price includes valves and Rola 5F Speaker and kit is complete to the last nut and bolt. (Set wired and tested. £2/15/ extra.)

Cabinet size, 11½in long, 7in high, 6in deep. Foundation Kit for above comprising Bakelite Cabinet, Chassis and Dial Assembly .. 57/6

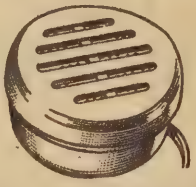
Post and Packing: N.S.W., 14/6; Interstate, 25/-.

NEW RECORD PLAYERS

4-speed B.S.R. Player with Turnover Crystal Pick-up and Amplifier in attractive Two-tone Cabinet.

£18/15/-
F.O.R.

PILLO-FONE EXTENSION UNIT



IT'S A REAL MINIATURE WITH ROLA UNIT.

Install it anywhere, in the sick room, workshop, garage or any room in the house. Just connect across voice coil of the existing speaker. The 'PILLO-FONE' IS THE MOST CONVENIENT LITTLE UNIT YET DEVISED.

3½in Diameter by 1¾in deep. POST FREE. 22/6

NEW VALVES AT BARGAIN PRICES

6J6	12/
ECH 35/VR99A, Direct replacement for 6J8G	10/
1C4	7/6
1T4	4/6
1S5	10/
3S4	10/
1R5	12/6
1A7GT	9/6
1D8GT	9/6
6A8G	10/6
6K8G	9/6
6SJ7GT	9/6
12K8	10/
EK32	10/6
6SA7GT	9/6
6SH7	5/6
1Q5G	4/
1P5G	2/6
1C7G	3/
1K5G	2/6
1M5G	3/
1K7G	3/
1L5	9/6
6C8G	5/
6SS7	8/6
6H6	2/6
6H6GT	2/6
6K7GT	7/9
6U7G	7/6
6J7G	5/
7C7	3/6
78	7/6
EL32	10/6
6B6S VRSS	
6V6GT	12/6
VR65A	2/6
41	7/6
7193	3/6
954	2/6
12A6	7/6
EF50	2/6
811	£1
12SH7	5/
6K7G	4/6
1C6	7/6
955	2/6

SPECIAL PRICES FOR QUANTITIES.
Please add postage on all valves.

NEW VALVE SOCKETS

Ceramic EF50 sockets, 2/6 ea. American moulded Loctal, 1/ ea. Octal 8-pin water, 6/6 doz. Amphanol 5-pin ceramic, 2/6 ea. Amphanol small 7-pin ceramic, 2/6 ea. All post extra.

NEW MINIATURE COILS and I.F. TRANSFORMERS

Aerial, R.F. or Oscillator Coils, 7/6 ea. Post 1/. 4 V.F. Transformers, 9/6, Post 1/. Short Wave Coils, 16 to 49 metres, 5/6 ea.

NATIONAL RADIO SUPPLIES

322 PARRAMATTA ROAD, STANMORE, N.S.W. Phone LM7398

MAGNETIC SOUND INDUSTRIES (Aust.)
PRESENTS THE ULTIMATE IN TAPE RECORDERS

THE BRILLIANT NEW
GRUNDIG
STEREO
TAPE
RECORDER

with remarkable new hi-fi stereo amplifier

- ★ Play stereo records through it
- ★ Tape record stereo records onto it
- ★ Record music or voices stereophonically or monaurally (it's a full hi-fi monaural tape recorder as well)
- ★ Two speeds—3¾ r.p.m. and 7½ r.p.m.
- ★ Special trick button for multi recordings

FREE! A FREE REEL OF LONG-PLAY TAPE TO ALL BUYERS OF NEW TAPE RECORDERS WHO BRING IN THIS COUPON!

For the connoisseur of tape recorders, a magnificent instrument . . . priced at £295—including two loudspeakers and tape. Microphones are an extra.

HIGHEST TRADE-IN PRICES GIVEN ON YOUR OLD GRUNDIG TAPE RECORDER

CHOOSE FROM AUSTRALIA'S GREATEST RANGE OF TAPE RECORDERS — FROM £65 — or £10 deposit—all the famous names . . . GRUNDIG . . TELEFUNKEN . . PHILIPS . . PYE TECHNICORDA . . A.W.A. . . ELCON . . etc.

WE GIVE YOU BRAND-NEW FACTORY GUARANTEE ON ALL USED TAPE RECORDERS!

HIRING . . yes, you can hire a latest model tape recorder for just 25/- per day.

SPECIAL . . Clarion Battery Tape Recorder suitable for hi-fi recording of music or speech. Batteries last for 50 hours. New low price . . 49 gns.!

MAGNETIC SOUND INDUSTRIES (Aust.)
THE TAPE RECORDER SPECIALISTS
387 George Street, Sydney.
(2 doors from Kodak). BX4440, BX4587

MASER, PARAMETRIC AMPLIFIERS

Last month we presented an article describing a new device—the Tunnel Diode. Reference was made to Maser and Parametric amplifiers, devices which are equally unfamiliar to the average radio enthusiast. Though you may not be able to understand all the terms and references, this article from the General Electric Research Organisation will "put you in the picture" in regard to these new techniques.

By Dr Richard W. Damon

IN electronics, the weakest detectable signal is one that is barely discernible above the "noise." The signal-to-noise ratio, in fact, is a better measure of detectability than mere amplitude.

Until recently the greatest noise by far was introduced in the detecting amplifier itself. Now communication systems developments in the field of atomic physics have led to new concepts of microwave amplifiers, which eliminate the noise sources inherent in conventional amplifiers.

Physically these amplifiers are quite simple, consisting of a gas or solid placed in a microwave cavity — sometimes refrigerated, sometimes immersed in a magnetic field.

Instead of an electron current, these new amplifiers make use of the internal energy of molecules or of other sources of stored energy. In this way the noise is reduced to the level caused by thermal effects and, by cooling the amplifier, even thermal noise can be decreased to a negligible amount.

TWO TYPES

Two broad categories of amplifying devices are of interest. Although they are similar in external behaviour, their principles of operation differ.

One type depends on energy stored within individual atoms or molecules. These may be molecules of a gas, such as ammonia, or atoms in a paramagnetic solid, such as the chromium in potassium chromicyanide. This type of amplifier is called a "MASER," an acronym for the operating principle of "Microwave Amplification by Stimulated Emission of Radiation."

The other type, called a "parametric amplifier," depends on energy stored in a circuit element such as a capacitor or inductor.

Historically the basis for these new devices is found in research programs on microwave spectroscopy which began aout ten years ago.

These studies followed several lines of investigation. In gases, for example, the natural frequencies of rotation of many molecules lie in the microwave region, and when the microwave frequency passing through the gas corresponds to a natural frequency of the molecules, a resonant absorption of microwave energy is observed.

This type of spectroscopy has been of great value to the chemist, and supplements infrared spectroscopy in the study of molecular structure.

TECHNIQUES

Perhaps more important than the natural frequencies of the molecules are resonances observed when certain atoms are placed in a magnetic field. In this case, absorption occurs at a frequency which is proportional to the magnetic field, and is observed in nuclear magnetic resonance, electron paramagnetic resonance, and ferromagnetic resonance.

The nuclear and paramagnetic resonance techniques have been valuable in determining molecular structure and in studying the detailed interactions of atoms in solids. The ferromagnetic resonance behaviour has been used in many microwave circuit elements to provide attenuators, phase shifters, gyrators, etc.

These analytical techniques are based on absorption of microwaves. Recently it has been recognised that under certain conditions these systems can produce amplification, rather than absorption, of the incident radiation. This can be done by using the principles of either the maser or of parametric amplification.

We will discuss first the maser type of amplifier, which is based on the properties of atomic systems that happen to have a natural frequency or magnetic resonance frequency at the desired amplification frequency.

In any gas or solid, thermal effects excite a certain fraction of the atoms so that they possess internal energy, which can be released by the emission of radiation. The remainder of the atoms will absorb radiation at the characteristic frequency.

When the system of atoms is in equilibrium with its surroundings, there are more atoms in the absorbing condition than in the emitting state. Consequently if this system is exposed to radiation at its characteristic frequency, there is a net absorption of energy by the atoms, and less radiation comes out than was put in.

In constructing a maser, the trick is to find a way of putting energy into the material in such a way that more atoms are put in the emitting condition, and thus can radiate this energy at the characteristic frequency, to give a net emission, or amplification.

When working with a gas, the individual atoms can be moved about, and it is possible to sort out the emitting atoms. Techniques for accomplishing this were first proposed by Professor C. H. Townes, of Columbia University.

PROVIDES AMPLIFICATION

It turns out in some cases, for example, that the emitting and absorbing atoms move in different directions in an electric field gradient. By applying a strong field, the desired emitting atoms can be focused into a beam and directed into a microwave cavity, while the absorbing atoms can be thrown away.

This technique makes it possible in the gas maser to have only the emitting type of atoms in the cavity. When a weak microwave signal is passed through a cavity containing these atoms, the internal energy of the atoms is released as radiation that adds to the signal and provides amplification.

One limitation, however, arises from the inherently low density of atoms in a gas, which leads to a relatively small power output. Also, the emission from the gas atoms used is at a fixed frequency, characteristic of the particular atom. For ammonia gas, used in one device, this frequency is 23,870 Mc/sec. While different gases can perhaps be used in different frequency ranges, the device operates essentially at a fixed frequency. It is also limited to an amplification bandwidth of only a few kilocycles.

These properties of fixed-frequency, narrow-band operation make the present gas maser rather unattractive as an amplifier, but are outstanding characteristics for an oscillator to be used as a frequency standard. Here the known frequency is a great benefit, and the

THE PROBLEM:

Radio waves from interstellar space picked up by radio-telescope, radar reflections from a distant missile in flight: these are examples of weak electronic signals in low-noise backgrounds. Ordinary vacuum tubes, operating on thermally emitted electrons, are often too noisy to detect these faint signals. Science has now found ways to obtain practically noiseless amplification by directing microwaves into a stream of gas or against a chunk of a magnetic material.

28 ELIZABETH STREET, MELBOURNE

Sounding a note of Goodwill . . .

To all those people whom we have had the pleasure of serving during the past twelve months we extend every good wish for a happy Festive Season and a bright and prosperous New Year.

sincerely

Simon Gray Pty. Ltd.

AUSTRALIAN NATIONAL DISTRIBUTORS FOR THE WORLD'S FINEST AUDIO EQUIPMENT FOR RECORDING,
BROADCASING, ELEVISION AND THE GENERAL TRADE

Gift Worries ?

To help you choose—we have selected the following as ideal presents carrying our personal guarantee of quality.

★ **PORTABLE RECORD PLAYER** (as illustrated) 3 Speed . . .Takes up to 12in Discs. Fully Transistorized, £37/10.

(P.S. Our test model proved an unqualified success on a holiday cruise. Five day non-stop performance on same batteries. Excellent reproduction without loss of gain or turntable speed.)

★ **SONY TRANSISTOR RADIOS.** Exceptionally long range. Excellent performance with minimum battery drain. Attractive appearance, complete with leather case and accessories.

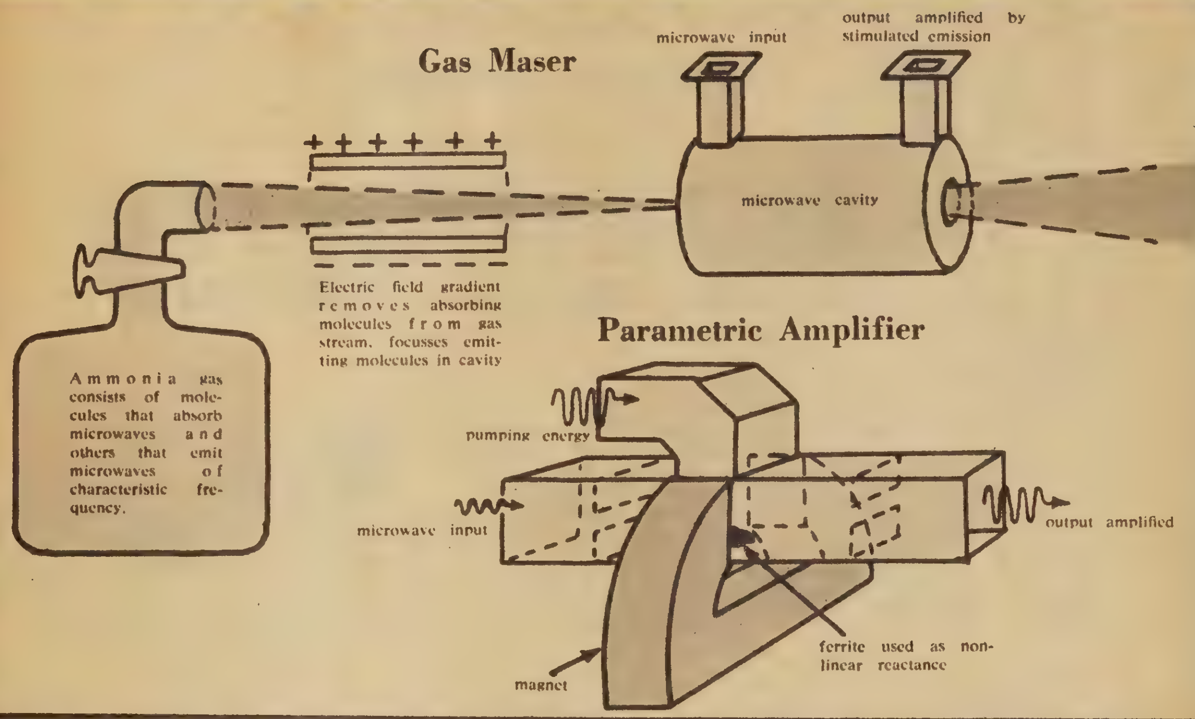
TR610 Pocket size	**£29/10/-**
TR84—8 Transistor, 800 hours playing	**£38/18/-**
★ **DUST BUG** Record Cleaner	**£2/13/11**
★ **STEREO** Records—from	**52/6d.**

VICTORIAN TELE-SERVICE PTY. LTD.

783 GLENHUNTLY RD., GLENHUNTLY.

PHONES 211-1038. 211-1039.

PRINCIPLE OF GAS MASER, PARAMETRIC AMP.


Gas Maser
microwave input
output amplified by stimulated emission
+ + + + + +
microwave cavity
Electric field gradient removes absorbing molecules from gas stream, focusses emitting molecules in cavity
Ammonia gas consists of molecules that absorb microwaves and others that emit microwaves of characteristic frequency.
Parametric Amplifier
pumping energy
microwave input
output amplified
ferrite used as non-linear reactance
magnet

The Gas Maser is illustrated at top left, the Parametric Amplifier at lower right. This article could well be read in conjunction with last month's feature on the Tunnel Diode.

narrow bandwidth leads to a very high degree of stability.

The operating techniques of the solid-state masers are quite different from those of the gas maser, and some of the properties differ markedly. The low-noise property is retained, however, and substantial improvements in gain and bandwidth are obtained.

Since the atoms are fixed in a solid, the sorting process used for a gas is not possible, and other methods of obaining a concentration of high-energy atoms must be employed.

The only method which appears pracical at present involves the use of relatively large amounts of microwave power to put energy into the system. An effective technique based on this method was proposed by Professor N. Bloembergen of Harvard University.

LOW TEMPERATURE

Operation at a low temperature, perhaps using liquid helium, is desirable both because this ensures a very low-noise figure and because the number of mitting atoms is inversely proportional o the temperature.

The solid, of course, is much denser han a gas and has more atoms in a iven volume. Therefore, the solid-state evice can provide much larger gain, or a given bandwidth, than the gas ype.

Another very useful property is the nability obtained by the use of paramagnetic salts as the active material. aramagnetic materials contain electrons hich behave like small magnets, and he frequency at which these magnets scillate in a magnetic field is proporonate to the field strength.

By using this oscillation frequency as he master characteristic frequency, the equency can be changed by varying the magnetic field strength. Operation from 100 Mc/sec. to as high as 100,000 Mc/sec. is feasible with this type of device, which is thus very suitable as an amplifier of microwaves.

These potential advantages appear to be well worth working for. However, advantages usually are not obtained for nothing; in the maser, they are partially offset by some limitations. As presently conceived the devices involve some techniques unfamiliar to systems engineers.

The paramagnetic maser, for example, is presently restricted to operation near the temperature of liquid helium (4 degrees K), and provision of this cooling may limit applications to relatively expensive installations. The gas maser can avoid the low-temperature requirement, but involves different complexities at some stages of the operation.

Another restriction lies in the relatively limited power-handling capabilities of these amplifiers. It appears that these devices will be limited to a maximum power output of a fraction of a watt, because of non-linear behaviour that destroys the amplifying properties at higher power levels.

The most important applications of these new amplifiers make use of the great increase in sensitivity, however, and conventional power tubes can be used after the maser has amplified the signal to a level above the noise of the standard receiver. Thus this restriction to low-power operation is not a very serious one.

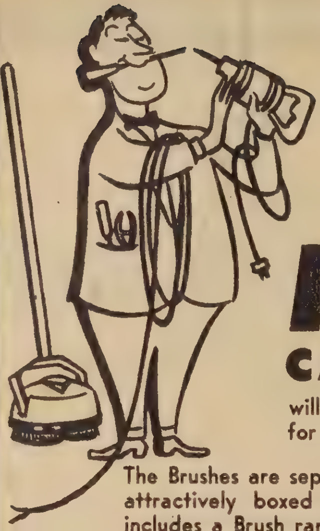
NOISE SOURCES

There is one further restriction of an operational nature. The extremely low noise of this amplifier has been mentioned previously as the principal advantage of the device. In systems use, however, there are other sources of noise.

One of these is the noise from warm

A FEW TERMS:

1. Paramagnetic:—A substance is said to be paramagnetic when it has a permeability greater than that of a vacuum, i.e. greater than unity.
2. Ferromagnetic:—A term describing materials having a permeability much greater than unity and which varies with the flux density. Iron and steel are the most common ferromagnetic materials.
3. Parametric:—Relating to constants derived from transmission circuits or networks.
4. Spectroscopy:—The practical study of spectra, including determination of wavelengths, etc.
5. Nuclear:—Having to do with the basic structure of the atom and involving electrons, protons, etc.



If you undertake simple repairs . . .

of domestic electrical appliances and tools, this small-pack

MORGANITE

CARBON BRUSH ASSORTMENT

will prove the most convenient, best-buying value for Brush replacements.

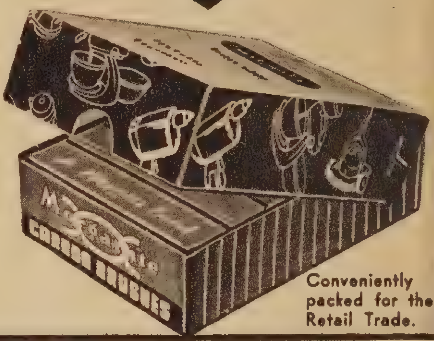
The Brushes are separately cartoned, individually numbered, attractively boxed for speedy handling. The assortment includes a Brush range for practically every domestic need. Refills immediately available by quoting type numbers.

Send for catalogue listing all Brush requirements for domestic use.

Available from your electrical wholesaler.

If unobtainable, write direct to the manufacturers:

THE MORGAN CRUCIBLE CO.
(AUSTRALIA) PTY. LTD.
Head Office: 65-67 Bourke Road, Alexandria, N.S.W. MU 1371
117 Thistlethwaite Street, South Melbourne, Vic. MX6106.



Conveniently packed for the Retail Trade.

Build this beautiful TRANSISTOR PORTABLE

Ivory and gold cabinet with handle.

Dimensions 6½" x 4" x 2."

COMPLETE SET OF PARTS —

Including LARGE LONG LIFE BATTERY

All you need is solder and a small soldering iron.

FULL INSTRUCTIONS—MAKE IT IN ONE EVENING.

GUARANTEED RESULTS

FULL INSTRUCTIONS

Price £15/15/0 Plus 25% Sales Tax

BUILD ONE FOR CHRISTMAS

or we will build it for you for small extra charge.

R.C.S.

651 Forest Road, Bexley, N.S.W.
LW3491-5385

R.C.S. Radio Pty. Ltd.

objects in the antenna beam, which contribute a fluctuating background signal interfering with detection of the desired signal. If the antenna is able to "see" an appreciable part of the ground, for example, these fluctuations correspond to a temperature of about 300 degrees K (room temperature).

This will be the noise background against which the signal must be detected, rather than the very low-noise background introduced by the maser. Under these conditions, the maser gives only a two- or three-fold improvement over a conventional amplifier.

This possibility of doubling the sensitivity of microwave receivers cannot be passed over lightly, but the maser can perform even greater feats in systems having a lower background noise. If the antenna is pointed upward, the background noise corresponds to the very low temperature of interstellar space.

Temperatures below 50 degrees K are common under these conditions and the advantages of the maser are then used to a much greater extent.

CHECKING ON MASER OPERATION

Principles of maser theory are studied with a magnetic resonance spectrometer by Dr. Richard W. Damon, author of this article.

The principle of parametric amplification has been known for many years to engineers working with non-linear systems, but recently Dr. H. Suhl of Bell Telephone Laboratories has shown how these principles can be utilised for microwave amplification.

The phenomenon is the same as that which causes undesired oscillations of electrical or mechanical systems, such as vibrations of turbogenerator rotors or the side rods of locomotives and oscillations of magnetic amplifiers. This prniciple is now being used to construct low-noise amplifiers.

TWO CONDITIONS

A circuit of the type shown in the accompanying diagram exhibits amplification if two conditions are fulfilled: (1) the sum of the resonant frequencies of the two tuned circuits is equal to the frequencies of the source, and (2) the non-linear reactance X is modulated by the source beyond a critical value which depends on circuit losses.

In this circuit currents from the pumping source (Fp) and from the signal (Fs) flow in the non-linear reactance (X). The non-linear behaviour mixes the two currents to produce sideband currents, Fp plus and minus Fs.

Since mesh 2 is tuned to the lower sideband, according to the frequency condition, Fp minus Fs equals Fi, only this component of current can flow in mesh 2, adding to current already present in this mesh.

In turn, this current (Fi) mixes with the source current and has a lower sideband at Fs. It is found that the phases are correct for positive feedback, and the current in both meshes builds up to a level determined by circuit losses and source power.

Above the critical source power necessary to overcome circuit losses, amplification is obtained.

Low-frequency circuits using conventional circuit elements have been constructed and operated using these principles.

At microwave frequencies, however, conventional circuit elements cannot be used. Instead, the resonant circuits of the diagram become a hollow metal cavity, with dimensions of the same order as the wavelength. Within the cavity, a ferrite material is placed to act as the non-linear reactance.

A source of microwave energy is used as a pump to feed energy into the ferrite, and for sufficient driving power, cavity losses are overcome and the device amplifies.

In the ferrite materials used in this device, the magnetism arises from the spin of the electron, just as the electron spin is responsible for paramagnetism in the materials used in the maser.

THE PUBLIC SERVICE OF

PAPUA AND NEW GUINEA

RADIO TECHNICIANS

Senior Radio Technician

(several positions)
£1,310-1,370 p.a. (single)
£1,435-1,495 p.a. (married)
(actual rates)

Qualifications: Qualified as P.M.G. Senior Technician (Radio) or equivalent.
Duties: In charge transmitting and receiving stations V.H.F., M.F./H.F., C.W. and radio-telephone trunk and out-station services

Radio Technician

(several positions)
£1,140-1,250 p.a. (single)
£1,265-1,375 p.a. (married)
(actual rates)

Qualifications: Qualified as P.M.G. Technician (Radio) or equivalent (persons qualifying this this year may apply).
Duties: Assist in maintenance and installation communications transmitters and receivers V.H.F., M.F./H.F.
Appointment: Permanent or fixed term appointment. Officers of Commonwealth Public Service will be considered for transfer pursuant to Section 43 of Public Service Act for period of up to two years in first instance.
Accommodation: Single quarters available; married accommodation unlikely be available under 18 months from date of appointment.
Separation Allowance: Payable at discretion of Territory Administration; designed to compensate for added expense of married appointees obliged to maintain family outside Territory.
Leave: Three months after each 21 months in Territory and 6 months' furlough after 20 years. If permanent, additional 3 months' leave after each 6 years.
Further Information: An information handbook on the Territory and its Public Service is available from Department of Territories, Canberra or Sydney, or from any Commonwealth Public Service Inspector, Commonwealth Employment Office or official country Post Office. Other inquiries to Department of Territories, Canberra ('phone 70411, ext. 29A).

APPLICATIONS

SUBMIT on prescribed form available from above offices
To—The Secretary, Department of Territories, Canberra, by
18th December, 1959.

REGD

EKCO - STYLUS

Sapphire and Diamond Radiogram Needles

for

Monaural and Stereo Discs

We are proud to announce that EKCO Diamond Styli are now within the reach of every music lover as the full range is available priced at ONLY £4.

There are other similarly priced styli on the market, but consider the facts:—
EKCO STYLUS Mirror-Finish gives you longer life.

Perfect Tip Radius ensures correct fitting in disc groove.

"Australian-made" means full technical assistance available to you.

For the Connoisseur and Hi-Fi Enthusiast we recommend the EKCO Professional Diamond Stylus, available at ONLY £7.

This Stylus is renowned for:—

MINIMUM MASS Tip giving Full Response.

PERFECTION POLISH giving the longest wear-free life.

HIGHEST ACCURACY RADIUS protecting your discs.

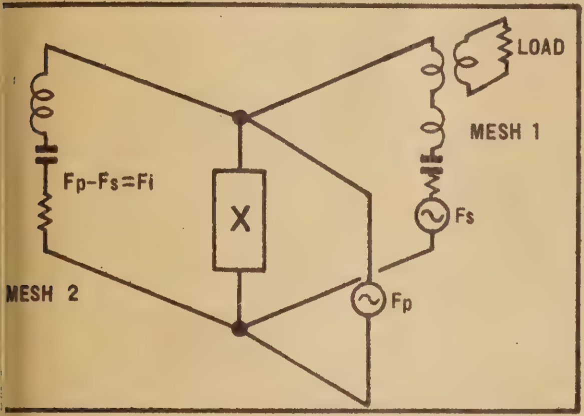
All types of EKCO styli are available throughout Australia.

If you have any difficulty in obtaining them, contact the manufacturer.

MANUFACTURED BY
ERNEST KUENZLI
PTY. LTD.
60-66 HUNTER ST., SYDNEY.
BW 6991

There is an important difference, how- er. In paramagnetic materials, only a ıall fraction of the spins contribute the net magnetisation, because ther- al agitation prevents many of the ins from lining up with an applied ld. In ferromagnetic materials, how- er, the electron spins are tightly coupl- together and act as a unit, so that arly all the spins line up with the ld.

The result is a net magnetisation so uch greater than that of a paramag- tic material that the latter is common- considered non-magnetic. Because of large magnetisation of ferromagnetic terials, this device also has a larger in-bandwidth product than the para- gnetic maser, while retaining the ad- ntages of tunability and low noise.



Illustrating the principle of a parametric amplifier, as discussed in the accompanying text.

A further advantage is that the mag- tisation of a ferromagnetic material nains large up to relatively high tem- ratures (the Curie temperature). Thus is not necessary to cool the material obtain a large number of active ms, as in the paramagnetic maser; device can be operated at room nperature.

Cooling is reouired only to the ex- t that it is necessary to obtain a low- ise figure.

TILL TESTING

Although all of these devices are still the laboratory stage, the principles operation have been investigated and feasibility of constructing useful de- es has been experimentally demon- ated.

Ammonia gas masers have been con- ıcted both as amplifiers and as oscil- ors at a frequency of 23,870 Mc/sec. e amplifier noise temperature is w known to be less than 20 deg. K amplification bandwidth is limited only a few kilocycles.

The oscillators have a long-time fre- ncy variation of less than one cycle second so the stability of oscillation he principal attraction of this device.

Paramagnetic maser amplifiers have n constructed by Bell Telephone oratories, Lincoln Laboratories, and ers, that operate at frequencies from 0 to 9000 megacycles per second when cooled with liquid helium e a noise temperature of less than deg. K.

Gain and bandwidth remain relative- small (about 20db and 0.1 Mc/sec.), can be improved by straightfor- d techniques. Verification of the low- se property has been the principal l of experiments performed to date.

At Bell Telephone Laboratories, Suhl's omagnetic amplifier has operated at m temperature with a frequency of 4500 Mc/sec. Early devices had gain of 25 db and a bandwidth of about 1 Mc/sec. This can undoubtedly be improved with further development.

The Research Laboratory program in this field, as noted above, is intended to provide the broad base of knowledge required for development of these devices. The work is concerned primarily with the paramagnetic maser and the ferromagnetic parametric amplifier, although preliminary studies are also being made of beam-type parametric amplifiers.

A broad class of paramagnetic materials will be investigated for their suitability in masers of various frequencies, bandwidths, and power levels. This requires detailed knowledge of the spectrum, resonance line width, and high-power behaviour of the paramagnetic salt.

Crystals of some ferromagnetic materials are also being prepared for studies of non-linear behaviour and of the coupling mechanism to the modes used in parametric amplifiers.

Still other investigations are concerned with an improved understanding of the sources of noise in these amplifiers, and of the means by which such devices can be applied in microwave systems.

Although a great deal of development is required to produce practical amplifiers, the tremendous improvement in noise figure and the advantages of solid-state devices in ruggedness and long life make these new principles of great importance. It seems clear that amplifiers and oscillators of this type will have a great impact on the future of microwave systems.

ELECTRONIC TACHOMETER

(Continued from Page 59)

a capacitor (say 0.01uF — the height and width of the pulse not being critical. (Note, however, that the pulse width must be less than the time constant of the coupling network of the circuit, say 5 mS.)

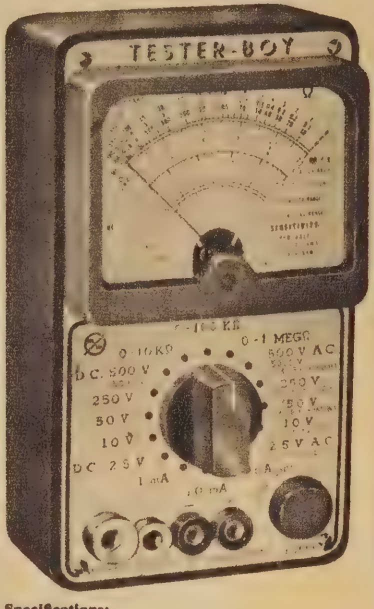
The resistance in the base circuit of T1 provides the calibration control — once the value is determined for a particular instrument, the potentiometer may be replaced by a fixed resistance of this value.

"The original scale on the meter can be redrawn to have a full scale deflection to suit the individual, but 5,000 r.p.m. full-scale deflection should be sufficient for most standard vehicles. Several points on the dial should be calibrated to ascertain that the instrument is linear.

"Several of these instruments have been built and mounted in different models of vehicles; all have performed reliably and accurately."

"TESTER BOY"

Complete with Leather Case
Test Leads and Batteries



Specifications:
Clear scale 3in x 2in.
Overall dimensions in carrying case. 4½in x 6in x 2½in.
1,000 O.P.V. highly damped movement.
Volts: AC and DC.
6 ranges to 5,000V.
Resistance: 3 ranges to 1 megohm.
Current: 3 ranges to 500mA.
Output: 2 ranges minus 20 to plus 56 db.

Price £7/10/-

Post—N.S.W., 2/3; Qld., Vic., Tas., 3/8; S.A., W.A., N.T., 5/.

IMPORTED RADIOS

Miniature Diode Crystal Sets with earphone.
Sputnik Model, 3½in high £1/19/6
707 Jet Plane Model, 9in wing span, £1/19/6
Rocket JRI Model, 5in high £1/19/6
Miniature Case Models.
Fuji. 56E, 2½in x 3¼in x ¾in .. £2/19/6
Shield RA277, 3½in x 2½in x 1in, £3/15/
Crown GR10, 2½in x 1¼in x 1¼in, £4/15/
1 Transistor and Diode with Earphone.
"Crown" Model TR1, 3½in x 2in x 1in, £5/9/6
"Faraday" Model TRIA, 3¼in x 2in x 1in, £4/18/
2 Transistor with Earphone.
"Beacon" Dual Wave, 2 bands, 4½in x 2¾in x 1¼in. £10/10/
Transistor with Speaker and Earphone.
3 Transistor "Crown" portable Radio, 4in x 2½in x ¼in. £14/19/6
4 Transistor "Aiwa" portable Radio, 5in x 3in x 1¼in. £19/17/6
6 Transistor "Sydney" portable Radio, 6in x 4in x 1¾in. £22/10/
6 Transistor "Sanyo" portable Radio, 5in x 3in x 1½in. £24/15/
7 Transistor "Toshiba" Dual wave portable, 7in x 4in x 2in. £33
8 Transistor "Sanyo" Dual wave portable, 6½in x 3½in x 2in. £44/2/
Portable Dual Wave Models with Telescopic Aerials.

Write for your free copy of our Resistor Colour Code

MAIL ORDERS

Radio House Pty. Ltd.
296 Pitt St., Sydney
Also available at: 6 Royal Arcade and 760 George Street, Sydney

Protecting Meters From Overload

OHMS ADJUST
AC
DC

Don't let this happen to you! To be honest, our artist "bashed" this meter for us, but the effect may be all too realistic for some of us. Read how you can avoid it.

To anyone who has ever "bashed" a meter—and that means most of us at one time or another—this article should read like a dream come true. It tells how modern silicon diodes can protect meters against almost all likely overload conditions. They can be used with most meter movements, cost very little, and do not upset sensitivity or linearity.

IN the September issue of this year we discussed some of the problems of maintaining accuracy in the average multimeter.

We pointed out that one of the major hazards was the accidental overloads which most meters encounter from time to time, and went on to show how these distort pointers and other parts of the movement, ruin the balance and upset both sensitivity and linearity.

We also pointed out that such overloads, while theoretically due to carelessness, still occur in practice; and even to the most careful operator at some time.

At the best, the pointer will be bent a few degrees, creating the problems already mentioned. At the worst, the meter movement may be a complete "write-off," the pointer being a tangled mess, the springs ruined, the coil jammed or even burnt out in extreme cases.

Some means of protecting meters against such accidental abuse has long been sought and a number of approaches have been made to the problem. A question we are often asked is whether it is possible to fit a suitable fuse to do this job, and it is easy to understand this reaction on the part of someone who has bashed a meter for the first time.

NOT THE ANSWER

Unfortunately, a fuse falls a long way short of requirements. In the first place, we are dealing with values of current ranging from 1 mA down to, say, 50 uA, and fuses to operate at or near these values may be difficult or impossible to manufacture, at least on a practical basis. At the best, they could be quite expensive.

The lowest value fuse on the Australian market appears to be a 10 mA type, and these cost about 4/6 each.

Smaller types are possible, and 2 mA types are listed in some overseas catalogues, but, even assuming such types were available, it is unlikely that they would help much.

The main trouble is that a fuse cannot respond rapidly enough to protect the meter, even when it is carefully designed for rapid action. Remembering that a meter which is overloaded can move across the scale in double quick time, it is easy to appreciate that the pointer will have arrived at the far stop and wrapped itself around it while the fuse is still trying to raise itself to melting point.

So, apart perhaps from some special applications, fuse protection of meters is of little practical value.

MECHANICAL CUT-OUT

A more satisfactory scheme is that adopted by some meter manufacturers, who have designed very ingenious mechanical cutouts as part of the meter movement. These are very effective and reliable, but, fairly obviously, are of no value where we want to add protection to an existing meter.

The latest approach is to use some form of non-linear resistor in parallel with the meter movement. A non-linear resistor is one which varies its resistance value according to the voltage applied to it, having, for example, a high resistance at low voltages, and a low resistance at higher voltages.

(A gaseous regulator tube is one example of non-linear resistance. Below a certain critical voltage its resistance may be regarded as infinite for most practical purposes, dropping to a few ohms once the critical voltage is reached. Although the characteristic is ideal, the voltages involved are too high to be suitable for meter protection.)

Such a resistor, if it has suitable characteristics, will have such a high value of resistance at normal meter voltages that it will have little or no effect on sensitivity. However, at higher voltages its resistance will drop sharply, thus acting as a protective shunt.

In addition to shunting most of the excess current, the presence of a low resistance across the meter coil has a pronounced damping effect on the movement. Thus, any overload that does occur is unable to move the pointer as rapidly as would otherwise be the case, providing further protection against mechanical damage.

by Philip Watson

OLDER VERSIONS

This is not a new idea, and the scheme has been suggested several times in the past. However, until recently, the best available non-linear devices were copper oxide and selenium diodes, and these had some limitations. The copper oxide type did not change resistance rapidly enough beyond the critical point, nor drop to a low enough value to provide adequate shunting.

The selenium type had a better rate of change, but still offered too much resistance for many applications.

However, both were used with some success in certain cases. In particular, they were best suited for use with high resistance meter coils, from 1,000 to 3,000 ohms, as used for high sensitivity movements. Here their shunting action was more effective than for, say, a 100 ohm coil. Their use was logical, since the expensive high sensitivity instrumen is more in need of protection than the cheaper, lower sensitivity variety.

The rapid development of silicon to replace both selenium and copper oxide in many applications offers a new line of attack against this problem. It i worth considering the general characteristics of silicon diodes in order to understand this better.

The accompanying diagram shows iow such a diode behaves when various alues of voltage are applied in both olarities. As can be seen, there are wo critical values followed by a sharp ise in current (fall in resistance) which night be suitable for our purpose.

One is the zener breakdown point, or 'zener voltage" as it is usually called. rior to the voltage reaching this point he resistance is very high, several megohms normally, but falls very rapidly to nly a few ohms once this point is assed.

In this respect, i.e., the steepness of he breakdown slope, the zener characeristic is very close to the theoretical deal. Where it is capable of being used t should be able to provide near perfect rotection for a meter. Unfortunately, he lowest practical zener voltage which eems to have been produced so far is round 2 volts, with current local types eing nearer 3 volts. This limits its pplication to special meter circuits deigned to use it.

FORWARD CHARACTERISTIC

The other critical point is part of the forward characteristic, and occurs around .6 volt. It also is quite sharp and a typical diode will have a resistance of 10M at .1 volt, falling to 5K at .5 volt and 2 ohms at 1 volt. Thus, we start to get some protective action around .8 volt, with very little chance of the pressure rising above 1 or 1.1 volt.

This, then, appears to be the lowest voltage at which we can hope to achieve protection. Relating this to typical meter movements, we find that these commonly have a full-scale deflection sensitivity of around .1 volt. Movements of 1 mA, 100 ohm; 100 uA, 1,000 ohm; or 50 uA, 2,000 ohm, would have this sensitivity.

Thus there is a gap between the full-scale deflection of the meter and the point where the protective device takes over. This brings us to the first point to be considered in the practical application of the silicon diode; the order of the gap and the meter's ability to withstand the overload which occurs between its two limits.

HOW MUCH OVERLOAD?

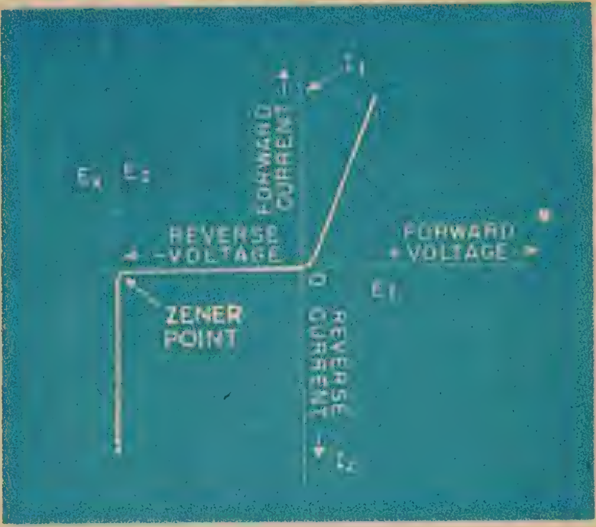
Determining the gap is mainly a mater of determining the voltage at fullcale deflection, the silicon diode charcteristics being essentially constant. Jsing the figures already quoted, we find hat the meter will be subjected to omething between 8 and 10 times overad before it is reasonably protected, aving us the task of determining how a articular meter is going to stand up this abuse.

In special cases it might be possible to educe the overload which the meter has carry. Where, for example, voltmeter anges only are involved, there would ppear to be no reason why the diode hould not be connected across part of e multiplier resistance as well as the eter. In this way the voltage across e diode would be increased for the ame full-scale deflection, and the gap educed in proportion.

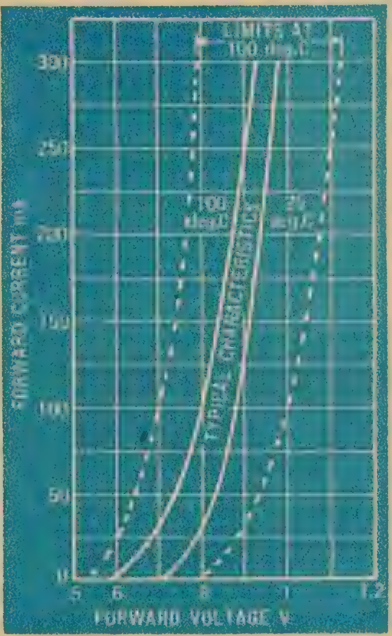
Unfortunately, there is not very much formation available on the subject of verload, or even any agreement on how determine precisely when the point f dangerous overload has been reached.

SILICON CONDUCTION CURVES

Typical reverse and forward characteristics. The latter is best suited to our problem. Note that the reverse current normally is plotted in microamps and the forward current in milliamps or amps.



Below: The forward characteristic in greater detail. Note the steep rise in current after .7 volt and the steep slope between this point and 1 volt.



The only point on which there is fairly general agreement is that the problem is mainly mechanical, i.e., overloads will wreck the movement long before there is much risk of coil burn out.

One overseas authority established a standard of overload based on the degree of pointer bend produced, setting the maximum overload as that which caused it to bend 1 per cent of full-scale deflection. On this basis he claimed that well-made microamp meters could withstand overloads between 150 and 225 times!

While not doubting the accuracy of his observations, two points would seem worth considering. One is that this amount of pointer bend would unbalance most meters more than might be imagined and may not, therefore, be a good basis on which to work. The other is that the meters concerned would appear to be considerably more rugged than the average.

At the other end of the scale, some meter manufacturers are inclined to be rather conservative, quoting figures between three and five times as being all that can be tolerated.

In between these two extremes we found frequent reference by local authorities to 10 times as being a figure which most manufacturers seem to regard as a minimum. This was encouraging, at least, and suggested that we were on the right track.

The only way to answer the question properly was on a try-it-and-see basis, but we had no intention of deliberately risking our own workshop meters so carefully calibrated only a few months ago. Instead, we sought the aid of a local meter manufacturer in providing something we could bash if we wanted to.

EXPERIMENTAL METERS

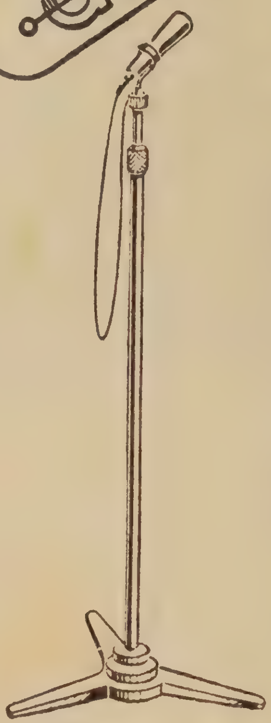
University Graham Instruments Pty. Ltd., very obligingly loaned us a couple of uncalibrated meter movements with which to experiment. Since no time had been spent on calibration, no one was likely to be particularly worried if the worst happened and the pointer finished up wrapped around the stop.

The next point was to choose a suitable silicon diode from those available on the local market. In general, the type required is one of the medium duty power rectifiers, having a continuous forward current rating of around 500 mA. Typical types are the RS20, FST 1/4, 1N1763, CK935, OA210, etc.

The choice may be narrowed somewhat on consideration of cost, since some types have a high inverse peak voltage rating, which is unnecessary, and are dearer than lower rating types. On this basis, the FST 1/4, 1N1763, and CK935 would seem to be the best choice, costing around 14/ each.

Since the diode gives the required characteristic for voltage of one polarity only, a single one will leave the meter unprotected in the event that the overload voltage is reversed. Generally, a meter can withstand more overload in the reverse direction, due to the limited

MICROPHONES AND FLOOR STAND

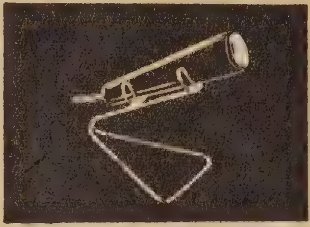


ACOS FLOOR STAND

Tristand for use with all types of stand microphones. Top of the extension arm is ⅝in x 26 TPI std. thread. The base and lower tube is finished in silver varitone, the extension arm being chromium plated.

DIMENSIONS: Base diameter . . . 17 inches. Height . . . Min. 3ft 3in. Max. 5ft 6in. Weight . . . 11 pounds.

PRICE £5-6-0.



CRYSTAL STICK MICROPHONE, MIC39-1

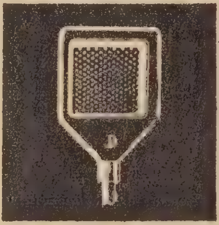
The MIC39-1 has been beautifully styled as a hand, desk stand or floor stand unit, and precision engineered to the highest professional standards. A heavy die-cast liner in the microphone case eliminates the possibility of hum pick-up due to hand capacity effects. The use of a special noise-free cable improves screening and gives a greatly increased signal-to-noise ratio. Designed especially for high quality recording, broadcasting and public address work.

PRICE £8-19-6, complete with desk stand.

CRYSTAL MICROPHONE MIC40

The MIC40 has been pleasantly styled in a variety of two-tone colours to give a handsome quality Microphone of modest dimensions and unassuming price. Ideal for tape recorders with a minimum of stowage space available, and a wide range of domestic applications.

PRICE £3-19-6.



LAPEL MICROPHONE MIC28

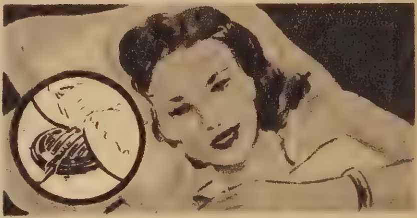
Designed to give freedom of movement, this Microphone is small and non-directional. Housed in a soft moulded rubber case which gives protection against shock, it is provided with a pin at the rear of the case for pinning to the lapel.

PRICE £5-19-6

STRINGED INSTRUMENT AMPLIFIER, TYPE VP1.

The VP1 Vibro-Voice has been specially designed for use with guitars, double bass and in fact all stringed instruments. With the use of this simple yet effective pick-up together with a good quality amplifier any instrument can be amplified. The VP 1 has an ample output and a frequency range which extends to approx. 5 K/cs. The tough rubber case protects the instruments from damage. Easily connected to the PU input of your amplifier or radio with a resistance of 5 megohms in series with the inner core of the cable.

PRICE £7-15-0.



ACOS PILLOTONE

Replaces irritating headphones and enables the individual listener to relax, head comfortably settled on a cushion or pillow. Although giving the reproductive qualities of a normal loudspeaker the Pillotone is inaudible three yards away. The tone has been specially compensated to give perfect reproduction, the muffling effect of the pillow provides the correct base response. Apart from domestic use the Acos Pillotone is ideal for hospitals and can be completely immersed in disinfectant without harm to the unit.

PRICE £6-10-0.

Sole Australian Agents

AMPLION (A'sia) PTY. LTD.

101 Pyrmont Bridge Rd., Camperdown.
Sydney, N.S.W. Phone LA 6124.

Victorian Distributors: DISTRIBUTORS CORPORATION, 403 Bourke Street, Melbourne.

TYPICAL PROTECTION FIGURES

Total Current	Diode Resistance	Protected Meter Voltage	Unprotected Meter Voltage
5mA	5K	.5	.5
10mA	68.0 ohms	.68	1.0
50mA	16.5 ohms	.82	5.0
150mA	6.0 ohms	.9	15.0
250mA	3.8 ohms	.95	25.0
500mA	2.0 ohms	1.0	50.0

These figures were taken from the test set-up described in the article. They demonstrate very clearly the order of protection provided as the current rises above 10 mA. The meter was a 1 mA, 100 ohm model.

novement possible, but it still is possible o wreck things if the overload is severe enough.

Two diodes, connected in parallel but n opposite directions, will solve this problem, either one taking over as required. Thus the total cost of protectng a meter will be around 28/.

Having selected our diodes and ecured some samples, we set up one of he meters for a test run. The basic circuit consisted of a 6-volt battery and variable resistor in series, so that the current flow through the meter could be adjusted from a fraction of a milliamp up to several hundred milliamps.

To this was added a voltmeter (a VTVM) to measure the voltage across he meter under test, and a milliampmeter to measure the current through t. Finally we added the diode directly across the meter terminals.

EFFECT OF DIODE

Our first check was to run the meter up to full scale and note the effect of connecting and removing the diode. As we expected this was virtually nil, thus confirming that it would have no adverse effect on sensitivity or linearity.

Increasing the current slowly beyond his point we watched the voltage across he meter. At 5 mA there was .5 volt across the meter, which would have been normal anyway. But at 10 mA the voltage was only .68 rather than 1 volt, as would have been the case without the diode. As the current rose the effect of he diode became more and more evident until, at 500 mA, there was only 1 volt across the meter instead of 50.

Well, the diode was certainly doing its ob; it was now up to the meter to withstand this much overload. Reducing the current to 250 mA we opened the circuit and checked the zero carefully. Then, feeling somewhat apprehensive, we closed the 250 mA circuit again. The pointer flicked across the scale at what seemed an alarming rate and hit the stop with a shiver. We shivered, too!

NO DAMAGE

But on opening the circuit the pointer went back to the zero without the slightest sign of distortion. We tried it again —and again. Still no damage. We raised the current to 500 mA. The result was the same. Finally we just stood here, switching the current on and off and watching the pointer flick back and orth across the scale.

We have long since lost count of the number of times this meter has taken a 0 times overload, but it must be well over the 50 mark and there is not the lightest sign of zero error or other ault. It seems that this overload igure is a perfectly reasonable one, particularly when the damping action of the shunt is added to slow down the novement.

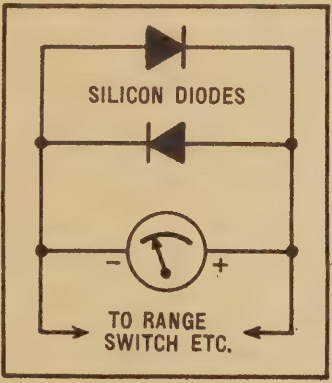
And, although we have concentrated our discussion on the 1 mA type of neter—it being one of the most popuar—there is no reason why the same protection cannot be applied to most other meters, including the more precius 100uA and 50 uA types.

With the latter, the main point to watch is that there is no noticeable hunting at full scale deflection, due to he higher coil resistance, a higher full cale voltage figure, or a combination of both. More than 2 per cent drop in sensitivity probably would be excessive.

Unfortunately, any serious shunting cannot be offset by simply increasing the meter sensitivity. Since such shunting will be effective only at full scale it will upset linearity as well as sensitivity. However, with the high resistance provided by the silicon diode and considering typical meter characteristics, this problem is unlikely to arise.

Having satisfied ourselves that the diode could protect the meter, the next question was what, if any, protection was needed for the diode. What would happen, for example, if conditions permitted more than 500 mA to flow through the diode?

These diodes have a fairly generous surge rating, ranging from 7.5 amps up to 35 amps, according to the type and the time involved. While these figures may be valid for periods of only 2 milliseconds or so, they do indicate that brief overloads of lesser magnitude can be tolerated.



The simple manner in which two diodes are used to protect a meter. A single diode will protect against forward overload, but two are needed for full protection. Suitable types are discussed in the text.

And, should a diode fail, it will "fail safe" by breaking down to a very low resistance — virtually a dead short — and thus continue to protect the meter. Of course, we are down by the cost of a diode, but this is generally preferable to the cost of a meter overhaul, remembering that an overload which will wreck the diode would make an awful mess of the meter.

Furthermore, the meter may be put back into service immediately by simply removing the faulty diode. If a spare is not available the second diode may be reversed to provide forward protection at least, on a temporary basis.

(Inquiries regarding servicing costs suggest that repairing even a minor amount of damage and restoring correct balance will set the owner back by about £2/10/ while a major "prang" will cost a good deal more.)

As far as we can determine, there is only one condition likely to overload the diode. This is if one of the lower current ranges happens to be connected directly across a HT line. The trouble is caused not so much by the voltage as by the energy stored in the final electrolytic, and which gives the supply, momentarily, a very low impedance.

GETTING TOUGH

We tried this with a 300 volt HT line. For a start we connected the meter through about 5,000 ohm resistance, then gradually reduced this to less than a 1,000 ohms; a value which, in the normal way, would have given little protection. Nothing drastic happened to either the meter or the diode.

Then we omitted the resistance altogether. As we expected, the diode was sacrificed, but we were happy to note that the meter pointer did not even reach full scale, coming to rest at about .8 mA. Such an error might be more costly than we would like, but its a lot cheaper than a meter repair. Voltage sources other than the HT line, and having even a few hundred ohms impedance, would be unlikely to cause trouble.

This raises the question of fuses once again, and most overseas workers suggest that it is a good deal more feasible to protect a 500 mA diode with a fuse, than it is a 1 mA meter. In other words, the diode should increase the maximum permissible current to a value which can operate a fuse.

NOT SO SIMPLE

At first glance, this sounds like good reasoning and it would seem perfectly feasible to fit a fuse of, say, 100 mA rating and feel reasonably sure that this would blow before the diode was seriously overloaded. It probably would, too, but the big snag is the resistance of such a fuse, being around 15 ohms. Unfortunately, one cannot simply drop an odd 15 ohms into a meter circuit without seriously upsetting calibrations, particularly when this value is purely nominal.

The main problem is the current ranges. Voltage and resistance ranges probably could be fused in such a way that the added resistance was of little or no consequence, but these ranges are the ones least in need of protection.

MELBOURNE TAPE RECORDERS PTY. LTD.

255 Elizabeth St., MU4598 AND 271 Swanston St., Melb. FB2330

WE HAVE MUCH PLEASURE IN JOINING WITH PHILIPS IN THE PRESENTATION OF 2 NEW MODELS WHICH GIVE YOU THE CONVENIENCE AND PERFECT PERFORMANCE OF TOUCH CONTROL AND HIGH FIDELITY

Model ER 1500A Professional
Fidelity to 18 K.C. 3 Speeds
149 gns.

FEATURES

New design Hi-Fi Heads.
Fully Automatic Piano.
Key Push Buttons.
Full mixing facilities.
Monitoring facilities.
Exclusive Modulation Indicator.
Fully shaded Tone Control.
Built-in Programme Indicator.
Safety Lock Button.
Easy and certain maintenance.
Foot Controls and Head Phones available.

Model EL3515A
3¾ I.P.S.
7in spools
Push Buttons

Frequency to 12 K.C.
A Little Beauty
AT ONLY **99 gns.**

We have the famous GRUNDIG NIKI transistor battery operated PORTABLE TAPE RECORDERS limited number at only

99 Gns.

TECNICORDAS UG6 MODEL
Complete with mike, tape, etc., and extension speaker outlet.
Snap these up at

89 Gns.

TELEFUNKEN

2 Brand New Models

75K	85K
£159/9/6	£195/15/0

See the "CLARION" German built transistor operated battery portable. Records and plays back. only a few left at

48 Gns.

Demo Models GRUNDIG TK20
Usually £139/10/-
Our Price
Only 3 of these **£110** Full guarantee

FAMOUS "WALTER" RECORDERS
new shipment just arrived
new and complete

65 Gns.

See our large range of used but FULLY RECONDITIONED RECORDERS

From £49/10/0

There is nothing to compare with the GRUNDIG STENORETTE for all office dictation and conference recording
Price lists and brochure on application.
Demonstration gladly arranged.

WE ARE THE SPECIALISTS

METERS — Continued

They normally contain enough resistance to limit the current to a safe diode value.

The current ranges, on the other hand, are most vulnerable, due to the low resistance they present to the unwanted current. And, because they are low-resistance circuits, such a fuse resistance becomes intolerably high.

It might be possible to reduce the meter "swamp" resistance by this amount to allow for the fuse, but a number of problems present themselves. One is the fact that the fuse resistance may vary considerably, and another the problem of contact resistance in the fuse holder. Both could alter the meter sensitivity in a purely random fashion.

LOWER RESISTANCE

Larger fuses, such as 500 mA types, have only one or two ohms resistance and probably could be tolerated. However, their protective efficiency is doubtful. A typical fuse of this type is listed as requiring 25 amps in order to blow within 1-100 second. This is far too much current for too long, as far as the diode is concerned. "Quick-blow" fuses would undoubtedly do better than this, but are not very readily available.

All things considered, we feel that fuses are not likely to prove a worthwhile proposition at the moment. If, later on, something better comes to light, the situation may be worth examining again.

While pondering on this problem it occurred to us that it might be possible to re-design a typical multimeter circuit in such a way as to ensure that there was always enough resistance in series with the diode to eliminate destructive current surges.

One idea which appeals to us (though requiring more detailed investigation) is to add a 100 ohm resistor in series with the meter-diode network so that, as far as the rest of the circuit is concerned, the meter appears to have 200 ohms resistance.

NEW SHUNTS?

This should not seriously upset voltage or resistance functions, the main objection being the need to provide a new set of shunts. However, the cost might well be justified, since the greatest surge possible from a typical HT line would now be limited (by the added 100 ohm resistor) to around two or three amps. This value would be unlikely to damage the diode on a short-term basis.

The result might well be a virtually non-destructible home-made multimeter; something which most of us have only dreamed of in the past.

However, this will have to wait until we can check it more thoroughly. In the meantime, there is no reason why you should not go ahead and fit a couple of diodes directly across your favourite meter movement and enjoy the very considerable protection they can provide.

Remember, the scheme needs only to protect your meter against one careless act in order to justify its quite moderate cost.

THE 1959 KARSET

Two points have been raised by readers concerning the Hybrid Karset of June, 1959.

The first concerns the negative feedback line which is shown in two slightly different forms, one in the circuit on page 65 and the other in the wiring diagram on page 69.

Either of these two arrangements may be used successfully, the one on page 69 being the first arrangement tried and the one in the circuit being a modification which may offer some slight alvantage. Thus it is the preferred arrangement, but the difference is quite small.

The second concerns the 22K oscillator grid resistor for the 12AD6. This is shown returned to chassis but should, in fact, return to the negative side (A terminal) of the supply line.

STUDY OF WAVES

(Continued from Page 19)

recorder on a ship. The difficulty was overcome by fixing a pressure-sensitive instrument to the hull of the ship 10ft below the waterline. A ½in hole in the side of the ship measures the height of the sea above the hole. By suitable corrections to allow for the movement of the ship, an accurate record can be made of wave characteristics which enables the navigator to forecast wave conditions.

Radioed information from shore stations combine to bring about the forecast.

Prior to the war research on waves was mostly confined to artificial tanks where waves were produced by mechanical means. The most recent research has shown that these tanks were not effective enough, as wave formations simulating those produced by wind could not be attained. Wind waves are very complex and it is only by the pressure measuring system that they can be analysed.

Even on shore the pressure measuring device must be used in conjunction with meteorological charts in order to gain the greatest accuracy.

The largest period waves travel over great distances. Some travel as much as 600 miles before they reach their end on a coast.

A knowledge of wave science has been very useful to the British Government in a recent survey of a remote portion of the coast of Africa.

Planes flying at a very high altitude took photographs of the surf and associated foreshores. By close study the speed of the waves was determined and, by relating this information to the known behaviour of waves moving into shallow water (with due regard to the depths below) the scientists were able to provide the Government with a fairly close survey of the depths off the particular coast. Such is the wonders of present-day science.

AWA RONETTE

MICROPHONES & ACCESSORIES

Type C53

£4/19/-

Hand or stand mounting. Omnidirectional, black plastic housing and hand grip. Ideal for tape recorders and similar applications.

CHANDLERS PTY. LTD.

Albert and Charlotte Sts., BRISBANE

and leading wholesalers

BS
QUARTZ CRYSTAL
FREQ-KC
BRIGHT STAR RADIO
GLEN IRIS
MADE IN AUST.

VACUUM MOUNTED CRYSTALS

for general communication frequencies in the range 3-14 M.C. Higher frequencies can be supplied.

5.5 KCS. TV Sweep Generator Crystals £3/12/6 + 12½% sales tax.

100 KCS. & 1000 KCS. Frequencies Standard Crystals £8/10/- each + 12½% sales tax.

The following fishing craft fequencies are available in F.T. 243 holders: 6280, 4095, 4535, 2760, 2524, 2182, 4620, etc.

Immediate delivery available for all above types.

AMATEUR TYPE CRYSTALS 3.5 and 7 MC BAND

Commercials—from £3/12/6 each plus 12½% sales tax.

Amateur—from £3/-/- each plus 12½% sales tax.

Regrinds £1/10/-

Crystals for Taxi and Bush Fire Sets also Available

We would be happy to advise and quote.

New Zealand Representatives:—Messrs. Carrel & Carrel Box 2102, Auckland

BRIGHT STAR RADIO

46 Eastgate St., Oakleigh, S.E. 12, Vic. 57-6387

AUSTRALIAN BROADCAST BAND STATIONS — AN UP-TO-DATE LIST

Sign Call	Location	Frequency (Kc/s)	Authorised Power Watts
4QL	Longreach, Qld.	540	10000
7SD	Scottsdale	540	500
2CR	Orange, N.S.W.	550	10000
7BU	Burnie, Tas.	560	500
2ML	Murwillumbah, N.S.W.	560	200
6WA	Wagin, W.A.	560	50000
3WV	Horsham, Vic.	580	10000
4QR	Brisbane, Qld.	590	10000
7ZL	Hobart, Tas.	600	10000
4AT	Atherton, Qld.	600	500
6NM	Northam, W.A.	600	200
2FC	Sydney, N.S.W.	610	10000
3AR	Melbourne, Vic.	620	10000
4QN	Townsville, Qld.	630	50000
7QN	Queenstown	630	200
5CK	Port Pirie, S.A.	640	10000
6AL	Albany, W.A.	650	400
5DR	Darwin	650	2000
2NU	Tamworth, N.S.W.	650	10000
2BH	Broken Hill, N.S.W.	660	200
2CO	Albury, N.S.W.	670	10000
2KP	Kempsey	680	10000
4KQ	Brisbane, Qld.	690	*2000
6WF	Perth, W.A.	690	5000
2NR	Grafton, N.S.W.	700	50000
7NT	Launceston, Tas	710	10000
7QT	Queenstown, Tas.	720	500
2TR	Taree, N.S.W.	720	200
4QA	Mackay, Qld.	720	2000
6GF	Kalgoorlie, W.A.	720	2000
5CL	Adelaide, S.A.	730	5000
2BL	Sydney	740	10000
4QS	Toowoomba, Qld.	750	10000
2NB	Broken Hill	760	1000
3LO	Melbourne, Vic.	770	10000
6VA	Albany	780	2000
2KA	Katoomba, N.S.W.	780	*2000
4TO	Townsville, Qld.	780	*2000
4QG	Brisbane, Qld.	790	10000
5RM	Renmark	800	2000
6WN	Perth, W.A.	810	10000
2BA	Bega, N.S.W.	810	10000
2GL	Glen Innes	820	10000
3GI	Sale, Vic.	830	10000
6GN	Geraldton	830	2000
4RK	Rockhampton, Qld.	840	10000
2CY	Canberra, A.C.T.	850	10000
4GR	Toowoomba, Qld.	860	2000
7HO	Hobart, Tas.	860	2000
6KG	Kalgoorlie, W.A.	860	2000
2GB	Sydney, N.S.W.	870	5000
3UL	Warragul, Vic.	880	*2000
4WK	Warwick, Qld.	880	*2000
6PR	Perth, W.A.	880	2000
5AN	Adelaide, S.A.	890	2000
2LM	Lismore, N.S.W.	900	*2000
7AD	Devonport, Tas.	900	500
6BY	Bridgetown, W.A.	900	2000
4QB	Maryborough, Qld.	910	2000
2XL	Cooma, N.S.W.	920	*2000
4VL	Charleville, Qld.	920	1000
6NA	Narrogin, W.A.	920	2000
3UZ	Melbourne, Vic.	930	5000
4QY	Cairns, Qld.	940	2000
7ZR	Hobart, Tas.	940	10000
2UE	Sydney, N.S.W.	950	5000
3BO	Bendigo	960	1000
4AY	Ayr, Qld.	960	*2000
6TY	Bunbury, W.A.	960	2000
5DN	Adelaide, S.A.	970	2000
2KM	Kempsey, N.S.W.	980	*2000
6AM	Northam, W.A.	980	2000
2GZ	Orange, N.S.W.	990	2000
3HA	Hamilton, Vic.	1000	2000
6PM	Perth, W.A.	1000	2000
4RO	Rockhampton, Qld.	1000	2000
4CA	Cairns, Qld.	1010	*2000
6GE	Geraldton	1010	2000
4IP	Ipswich	1010	1000
7EX	Launceston, Tas.	1010	2000
2KY	Sydney, N.S.W.	1020	5000
3DB	Melbourne, Vic.	1030	5000
5PI	Crystal Brook	1040	2000
2CA	Canberra, A.T.C.	1050	2000
4SB	Kingaroy, Qld.	1060	2000
2RG	Griffith	1070	*2000
6WB	Katanning, W.A.	1070	2000
2MO	Gunnedah	1080	1000
6IX	Perth	1080	2000
7HT	Hobart, Tas.	1080	2000
3LK	Lubeck, Vic.	1090	2000
4LG	Longreach, Qld.	1100	2000
6MD	Merredin, W.A.	1100	2000
7LA	Launceston, Tas.	1100	2000
2UW	Sydney	1110	5000
4BC	Brisbane, Qld.	1120	2000
2AD	Armidale, N.S.W.	1130	*2000
6CI	Collie, W.A.	1130	2000
3CS	Colac, Vic.	1130	1000
2HD	Newcastle, N.S.W.	1140	2000
2WG	Wagga Wagga	1150	2000
4BM	Marborough, Qld.	1160	2000
5PA	Penola, S.A.	1160	2000
2CH	Sydney, N.S.W.	1170	5000
3KZ	Melbourne	1180	5000
2NZ	Inverell	1190	2000
5KA	Adelaide, S.A.	1200	2000
2GF	Grafton	1210	*2000
6KY	Perth	1210	2000
3YB	Warrnambool, Vic.	1210	1000
4AK	Oakey	1220	2000
2NC	Newcastle	1230	10000
3TR	Sale	1240	2000
2DU	Dubbo	1250	2000
9PA	Port Moresby, N.G.	1250	500
3SR	Shepparton	1260	2000
2SM	Sydney	1270	5000
3AW	Melbourne	1280	5000
4BK	Brisbane	1290	2000
2TM	Tamworth	1300	2000
5AD	Adelaide	1310	2000
3BA	Ballarat	1320	1000
3SH	Swan Hill	1330	2000
4BU	Bundaberg, Qld.	1330	2000
2LF	Young	1340	2000
3GL	Geelong, Vic.	1350	1000
4GY	Gympie, Qld.	1350	*2000
2NX	Bolwarra, N.S.W.	1360	2000
5SE	Mount Gambier, S.A.	1370	500
2LT	Lithgow, N.S.W.	1370	500
2GN	Goulburn	1380	2000
4MK	Mackay, Qld.	1380	2000
4BH	Brisbane	1390	2000
2PK	Parkes	1400	2000
2KO	Newcastle	1410	2000
3XY	Melbourne	1420	5000
2WL	Wollongong	1430	2000
2MW	Murwillumbah	1440	*2000
3CV	Maryborough, Vic.	1440	1000
5AU	Port Augusta	1450	500
2MG	Mudgee	1450	500
5MU	Murray Bridge	1460	500
2NM	Muswellbrook	1460	500
3MA	Mildura, Vic.	1470	2000
2BE	Bega	1480	1000
4ZR	Roma, Qld.	1480	*2000
2AY	Albury	1490	2000
2BS	Bathurst	1500	2000
3AK	Melbourne	1500	500
2NA	Newcastle	1510	10000
2QN	Deniliquin	1520	2000
5LN	Port Lincoln	1530	200
5AL	Alice Springs	1530	50
2VM	Moree	1530	*2000
2CN	Canberra, A.C.T.	1540	2000
2RE	Taree	1560	*2000
2LG	Lithgow	1570	200
3WL	Warrnambool	1570	200
4GM	Gympie, Qld.	1570	200
5WM	Woomera	1580	50
2WN	Wollongong	1580	2000
5MG	Mount Gambier	1580	200
4SO	Southport	1590	200
5MV	Renmark, S.A.	1590	2000
3NE	Wangaratta	1600	*2000

*Operates at night on reduced (usually half) power.

OVERSEAS SHORT WAVE STATIONS—NOTE:

"RADIO, Television and Hobbies" does not publish, nor do we have available, lists of overseas stations, frequencies, broadcast times, etc.

The only information of this type is as compiled by our shortwave correspondent, Mr Art Cushen, and published each month on the shortwave page.

For general information on shortwave and other stations, reference can be made to the "World Radio Handbook," available through most large technical booksellers.

AUSTRALIAN TELEVISION CHANNELS, STATIONS

Channel 1 49-56Mc.
Channel 2 63-70
(For use in inland country areas only)
Channel 3 85-92Mc.
Channel 4 132-139Mc.
(Available from July 1st, 1963)
Channel 5 139-146Mc.
(Available from July 1st, 1963)
Channel 6 174-181Mc.
Channel 7 181-188Mc.
Channel 8 188-195Mc.
Channel 9 195-202Mc.
Channel 10 209-216Mc.

UHF Channels are provisional only, 50 channels being envisaged between 500 and 855Mc. each 7Mc wide.

Stations which are currently operating or due to commence shortly are listed below.

All capital cities will use channels 2, 7, 9 and 10, except Hobart, which will use channels 2, 4, 6 and 8.

Allocations involving these and other channels have been made to about 50 other cities and/or country centres throughout the Commonwealth.

Sydney		
	ABN	Channel 2
	ATN	Channel 7
	TCN	Channel 9
Melbourne		
	ABV	Channel 2
	HSV	Channel 7
	GTV	Channel 9
Brisbane		
	ABQ	Channel 2
	BTQ	Channel 7
	QTQ	Channel 9
Adelaide		
	ABS	Channel 2
	ADS	Channel 7
	NWS	Channel 9
Perth		
	ABW	Channel 2
	TVW	Channel 7
Hobart		
	ABT	Channel 2
	TVT	Channel 6

HIGH FREQUENCY SERVICES:—

Call Sign	Location	Power (Watts)
VLG	Lyndhurst, Victoria.	10,000
VLH	Lyndhurst, Victoria	10,000
VLI	Sydney, N.S.W.	2,000
VLM	Brisbane, Queensland.	10,000
VLQ	Brisbane, Queensland.	10,000
VLR	Lyndhurst, Victoria.	5,000
VLT	Port Moresby, Papua	2,000
VLW	Perth, Western Australia.	2,000
VLX	Perth, Western Australia.	10,000

Frequency Modulation Services:—

Location	(Mc/s)	Power (Watts)
Melbourne, Vic.	90.4	2,000
Sydney, N.S.W.	92.1	2,000
Adelaide, S.A.	97.3	3,000
Brisbane, Queensland	91.1	1,000

ACOS
GP73-3
PLAYS ALL RECORDINGS!

NOW!
AN ACOS
HIGH OUTPUT TURNOVER
STEREO CARTRIDGE

Type GP73-3 has been added to the Acos range
High output—Good frequency response and separation
FOR USE WITH "ECONOMY" AMPLIFIERS
Available with 2 sapphire or diamond/sapphire styli.
Frequency response—40—12,000 c/s
Separation between channels at 1 K/cs better than 20dB.
Radii of Stylus tips—0.0007" 0.0025" Recommended load —2 Meg. Compliance = 3.5 ucm/dyne. Stiffness = 0.0286 x 10 dynes/mm
Recommended downward pressure — 5-7 grammes

PRICE £5/15/- with two sapphire styli
£11/18/6 with diamond sapphire styli

Sole Australian Agents
AMPLION (A'sia) PTY. LTD. 101 Pyrmont Bridge Rd., Camperdown, Sydney, N.S.W. Phone LA 6124.
Victorian Distributors: DISTRIBUTORS CORPORATION, 403 Bourke Street, Melbourne.

Let's Buy An Argument

The "Serviceman Who Tells" is at it again! This time he's bought an argument about whether one can or cannot locate objects causing ghosts on TV screens by looking at the image. If he keeps it up, I'll be getting him to write these columns while I brush up on servicing!

by *Neville Williams*

JUST to jog your memory, the Serviceman raised the question in the October issue by telling of two students whom he overheard discussing TV ghosts.

While at variance on another detail, they both agreed that the position of the ghost-producing object from the receiver could be deduced by observing the displacement of the spurious image and drawing a circle around the receiving location representing the equivalent distance.

The offending object would then lie somewhere on this circle and could probably be identified therefrom.

POSSIBLE POSITIONS

The serviceman said "no" and proceeded to point out that the object could, in fact, lie in the general area behind the transmitter, behind the receiver or to either side of the path between them. The only certain thing was that the position must be such that the reflected wave must have come by a path longer than the direct path by the appropriate distance, as deduced from the screen.

Having thus said, he suggested that such calculations were much more likely to be useful in confirming one's suspicions about some object or prominence rather than identifying it in the first place. Said he:

"So hunt for your ghosts with a slide rule by all means but make sure that you appreciate all the limitations, as well as the possibilities."

Now all this most obviously disturbed a number of readers, as evidenced by their letters to the "Serviceman," to the editor and to the technical editor.

It would be quite redundant to reprint all the letters in toto, since they say much the same thing. The one opposite, from J.L., is typical, though his figures are neither very consistent nor practical. However, the idea is clear enough.

From Tasmania, another reader, W.B. goes through the same explanation about constructing an ellipse, but has a different slant on pinpointing the ghost. He says:

"If the ghost were to appear on two different channels broadcast from different locations and assuming the same structure to be responsible for the ghost in each case, the task of location is simplified.

"In this case we get two intersecting ellipses with the culprit at one of the points of intersection. This, of course, is of no use if different objects produce the ghosts in each case."

"QUITE SIMPLE"

Other correspondents do not try to utilise intersecting ellipses but are content to explain in detail and with some slight caustic element that the problem is really quite a simple one mathematically. Says A.L., of Hyde Park, S.A.:

"You can do it mathematically, you know!

"A schoolboy could construct the ellipse on a plan or map from the data given and hence locate all objects which could be responsible for the ghost.

"Or it could be plotted from the algebra, with which I won't bore you.

"A highly directional array would pinpoint the offender, if this weren't obvious."

From Yarraville, in Victoria, a reader, J.S., comes up with yet another suggestion. I quote:

"I think that it would be possible to make a very simple little marker generator which would inject a series of light and dark lines into the picture at a spacing corresponding to ½-mile, by mixing into the video amplifier a differentiated square wave of 5.4usec p.r.f.

"LINE ON A MAP"

"This would enable the extra path length to be accurately estimated. A chart could be constructed which would enable anyone quickly to draw a line on a map.

"Unfortunately, I am unable to do any work along these lines at the moment, but would be interested to know if you think they are worth pursuing."

Well now, what can we make out of all this?

First and foremost, some of the argument appears to be based on the mere usage of terms, quibbling about the word, "mathematics." Discussion along these lines may be a pleasant enough diversion over lunch, but scarcely warrants a lot of space in these columns.

In fact, the "Serviceman's" remarks ren't entirely consistent because, while stensibly talking down mathematics, he as used them to define the path along vhich the offending object could be ound. Perhaps it's a little unfortunate hat he did not specifically state that is path is actually an ellipse and that could be constructed by such and such neans.

At the same time, I can't help but feel hat the correspondents generally have ecome so prepossessed with this matter hat they have ignored what, to me, eems the fairly obvious intentions of he Serviceman—namely to point out hat the plot is not a circle pattern and suggest further that such observations e treated with a great deal of reserve, nyhow!

OINT OF VIEW

It is further necessary to remember hat he is writing from the point of view f a serviceman, dealing with ordinary elevision installations, owned by ordinry people and living in a wide variety f localities.

This is really quite important.

The example quoted by the Serviceman is a fairly easy one involving a disance of 10 miles between transmitter nd receiver, with an additional path ngth of one mile for the ghost signal.

Now let's go to work.

From a local garage or a bookshop or motorists' association, one purchases a arge sheet map of the metropolitan area r the relevant portion of it. Now omes the problem of locating accuratey on that map the transmitting and receiving sites, remembering that on the nap scale involved, individual streets re not shown.

Try it for yourself and see.

Having done the best possible, however, one can then proceed to draw the llipse by the prescribed method. Two urther difficulties at once become aparent.

The first is that the map gives a very ttle topographical detail or close idenfication of the path along which the llipse lies.

The second is that one becomes painlly aware of a line 21 miles long inercepting hills, bays, rivers, headlands, ndustrial areas—in fact, the lot!

HE NEXT STEP?

And what of the next step? Should ne hire a helicopter to survey the path llipse or transfer the line to section naps with, we hope, enough accuracy be of some use?

And having done either or both, one nds up with a list of possible reflecting bjects, to be further eliminated or conrmed.

But remember that this is for a ghost .8in away from the main image. Plenty f ghost images are a lot closer—and ften a lot more troublesome—than this nd it becomes progressively more difficult to achieve the necessary accuracy n any ordinary sheet map.

As the loop narrows, one reverts to e rather elementary but very real ituation that the ghost source is proably very close to the line of transnission or in a "rough arc" behind or to he side of the receiving site.

The matho-mechanical action of drawing an ellipse on a map becomes largely redundant.

If more accurate maps are obtained, some of the aforementioned guesswork is eliminated, but the ellipse remains just as long as ever.

And what of the idea of intersecting ellipses?

WHAT CONDITIONS?

Under controlled and precise conditions, a good deal could possibly be deduced from such a procedure. Under "television" conditions, the same way may not be true.

When more than one receiving installation is concerned, the aerial systems may not be electrically symmetrical, even if they happen to be similar mechanically. Due to proximity effects, feeder and termination inequalities and to the rather irregular polar patterns of television aerials anyway, one receiver may "see" a ghost source which the other largely ignores and vice versa.

Unless one can be certain that each installation is "seeing" the same ghost source for a particular repeat image, an entirely misleading conclusion may be drawn.

The same kind of objection could be raised for one receiver observing different transmission channels. Even assuming that the transmitters are separated physically by a sufficient distance for the purpose, the polar diagram of the receiving aerial will inevitably vary from one channel to the other.

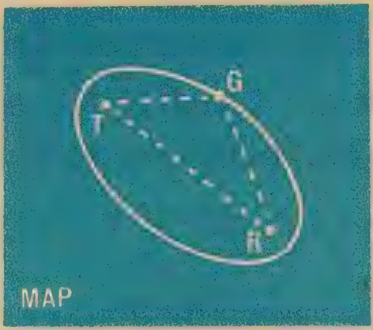
Whether it will continue to "see" the same ghost source on both channels, or different ghost sources, would be open to some debate. In fact, how many times have you heard the complaint, "I get a bad ghost only on channel so-and-so."

Well, then, adding together all these factors, it seems to me that the idea of

LOCATING TV GHOSTS BY MATHS

Dear Sir,

I refer to your article in the 1959 October issue (pp. 45 and 117) where you discuss the location of objects causing television "ghosts." It seems to me that this may be done quite accurately with mathematics, without the need to scan the countryside; indeed, the position may be pinpointed.



Now I apologise for the fact that I know little of radio mechanics and thus may be putting over a bogus theory. However, here it is:

You have shown how we can calculate the extra distance travelled by the ghost image and, for convenience, I shall use your example: i.e., 1.8in displacement on a 21in screen equals one extra mile of path length.

We now obtain from the local police or some other source, garages, etc., a map (preferably large) of the locality in question. We mark the positions of the transmitter and ghost-plagued receiver on this map and calculate from the map scale the distance between transmitter and receiver.

Suppose this is 50 miles. The distance travelled by the ghost is 51 miles. The sum of these is 101 miles.

Suppose the scale of the map is 1in to the mile. Make a loop of thread 101 inches long.

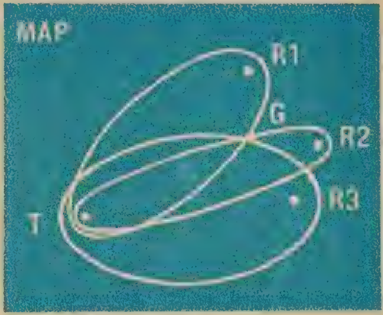
Lay the map on a firm surface and insert pins into the position of receiver and transmitter.

Hook the loop over the pins and draw an ellipse. (See diagram.) In this, T is the transmitter, R the receiver and G the source of the ghost.

All points on the ellipse are now such that the sum of T-G and G-R is 51 miles.

No doubt, more than one receiving set in the locality will be affected by the ghost.

Using the positions of the three such receivers which are a fair distance apart (the greater their separation, the greater the ultimate accuracy) we may pinpoint our ghost source, since the three ellipses will intersect at one point. (See second diagram.)



I hope this idea is of use provided, of course, that it is correct.

Application of co-ordinate geometry to the problem gives these conclusions but I am also aware that strange things may happen with radio which may invalidate these deductions.

How to eliminate the ghost, once found, is your bunny but at least you can find it accurately.

Yours faithfully, J.L.

A very Merry Xmas and a Happy New Year to all!

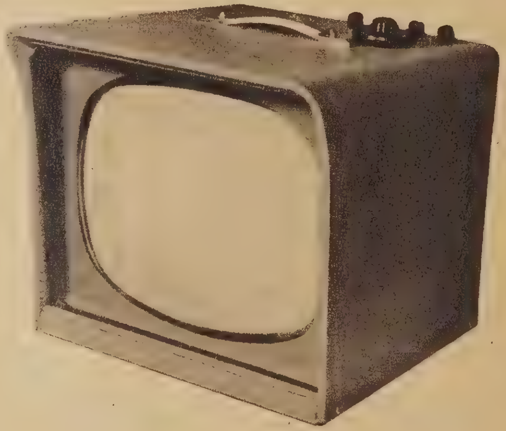
Q-PLUS

14" 110° T.V. KIT

Complete with all Valves including Picture Tube, Speaker, Cabinet, Safety Glass and Easy-To-Follow Instruction Manual

NOTE THESE FEATURES:

- ★ "Q-PLUS" TURRET TUNER FEATURING 10 CHANNELS, PRE-WIRED, TESTED AND ALIGNED WITH EASILY ADAPTABLE LOW-IMPEDANCE LINK OUTPUT.
- ★ "Q-PLUS" MARK V VIDEO I.F. STRIP COMPLETELY WIRED, TESTED, ALIGNED AND FACTORY SEALED FOR OPTIMUM PERFORMANCE.
- ★ FULLY RATED AND SCREENED POWER TRANSFORMER, UTILISING SILICON DIODE RECTIFIERS (NO "HOT" CHASSIS).
- ★ FULL QUERY SERVICE AVAILABLE AT ALL TIMES.
- ★ ONLY HIGHEST QUALITY COMPONENTS USED.
- ★ INCORPORATING LATEST CIRCUIT DESIGNS GIVING FULL PERFORMANCE WITH 14 VALVES AND 2 GERMANIUM DIODES.



★ CHOICE OF CABINET COVERING IN SPECIALLY SELECTED TAN OR BLUE P.V.C. FABRICS

99 GNS. COMPLETE

- ★ THIS KIT IS SUITABLE FOR CONSTRUCTION AS A 17 INCH MODEL WITH SMALL CIRCUIT MODIFICATIONS.

INCREASED PRODUCTION BY POPULAR DEMAND MAKES THIS KIT NOW AVAILABLE FROM YOUR WHOLESALER READY FOR XMAS CONSTRUCTION

R. W. STEANE & CO. PTY. LTD.

Head Office and Factory:
MELBOURNE — 2A MONTROSE STREET, HAWTHORN, E.3. WB3377-8-9.
Branch Office: SYDNEY—8 CADOW STREET, PYMBLE. JX3556.

Agents: Adelaide. W7021.
Wm. Matthews Ltd.

Brisbane: B1757.
Keith Percy and Co. P/L.

Perth: BA8911.
H. J. McQuillan P/L.

drawing ellipses and proceeding therefrom to a simple, straightforward conclusion is not nearly as neat and natty as might at first appear.

It might work out on some occasions quite neatly. In many others it may represent so much waste of time; time which could be better spent erecting and orientating the type of aerial which practice has established as suitable for the particular district.

After all, this will ultimately have to be done anyway!

Another thought has just occurred to me. If one is to go to the trouble of precision maps, then maybe the initial computation of the distance involved had better be tidied up.

The serviceman mentioned a figure of 1.8 miles per inch of displacement on a 21-inch picture tube. But that's a pretty general statement. Some receivers put just about the whole forward scan on the picture tube face; some habitually overscan by quite a bit each side; plenty vary their scanning width with the mains voltage.

PICTURE LIMITS

So, before one can be too precise about image displacement inches, microseconds and miles, it would be necessary to do a bit of fiddling with the width and/or centring adjustments, to discover the limits of the video information and the width between those limits.

Maybe the Serviceman's conclusion wasn't so far out after all:

"So hunt your ghosts with a slide rule by all means, but make sure that you appreciate all the limitations, as well as the possibilities."

And, finally, let me assure you of two things: (1) The Serviceman's reference to a slide rule was purely figurative; (2) He doesn't disdain slide rules; I happen to know he owns two of them!

While on the subject of television, may I direct your attention to a letter in the accompanying panel, headed "Picture Tubes For Christmas?"

It is very explicit and requires no further comment from me.

The second letter is one that brings us right down to earth again. After arguing about the precise effects of electric shock and various other reasonably "sophisticated" technical subjects, it comes as a jolt to realise that, on another plane, other readers are still worrying about the basic operation of a push-pull amplifier.

And why not?

Who among us, at some stage along the never-ending road to technical enlightenment, have not wondered about things which now seem very elementary indeed.

PICTURE TUBES FOR CHRISTMAS?

Dear Sir,

I have seen several references lately to the apparent reluctance of picture tube manufacturers to rebuild their own products when they have worn out.

In view of this, it may be interesting to observe that at least two manufacturers are buying back unserviceable picture tubes from servicing organisations. Since large numbers are involved, it seems not unreasonable to assume that these tubes are being rebuilt.

What then happens to the rebuilt tubes?

It is common knowledge that rebuilt picture tubes are not released for sale, or at least not certified as such.

Since I cannot believe that those involved would stoop to anything underhand, I am led to the conclusion, surely a very natural one, that the tubes are not rebuilt at all but are issued to the staff at Christmas time for use as novel loungeroom ornaments.

Yours faithfully, M.G.

HOW DOES PUSH-PULL WORK?

Dear Sir,

Below is the basis of an argument which I and various other people have tried to thrash out, but with no success. We therefore pass it on to you, hoping that you will publish the result in your magazine, for the interest of all concerned.

We read that, to operate a pair of balanced valves in push-pull, we must have two equal signals, 180 degrees out of phase, applied to the grids.

Now if this is so, we must have two equal signals at the plates but still 180 degrees out of phase.

If we consider a push-pull amplifier being fed a sine wave input, we should according to our reasoning get a sine wave output, 180 degrees out of phase.

These signals are fed through the output transformer.

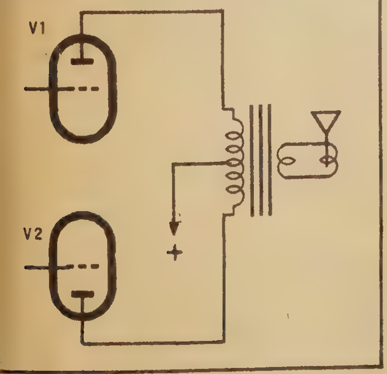
Now a simple graph will show that, if two sine waves 180 degrees apart are fed together, we will get a straight line — nil output!

This, then is the problem. How does a push-pull amplifier actually end up making any sound? Of course, we know that it does work in practice. But where have we gone wrong in our deductions?

Or does the phase splitter in some wonderful way contribute to the solution? Or is it the output valves? Or is it that we have just got into a mental rut and are thinking along the wrong line?

Thankful of getting this problem off my mind.

Yours in anticipation, K.H.



Basic push-pull output circuit.

I remember, on one occasion, asking the foreman of a receiver wiring line, quite seriously, why we didn't earth the filament winding of the 80 rectifier, like we did the other two heater windings.

I was surprised that he was surprised at my question.

In point of fact, the answer to the question by K.H. is simple enough.

Push-pull only works because the two valves deliver their output into a centre-tapped push-pull output transformer, which then passes the combined output into the load.

The accompanying circuit shows a simple, conventional push-pull output stage, involving two valves and a centre-tapped transformer.

ZERO GRID VOLTS

Imagine first, that there is no signal on either grid or, if you like, that the input signal at the particular instant is passing through zero.

Neglecting any slight unbalance in the valves, the two plates will be drawing the same instantaneous current. This passes through each half of the secondary but in opposite directions.

If you like to think in terms of conventional current flow, it could be said that equal currents flow from the centre-tap outward to the two plates. Alternatively, you may prefer to think of the same number of electrons flowing from the two plates towards the centre-tap.

However, the point is that the two currents oppose one another in their magnetising effect on the core and, since they are equal and flow through an equal number of turns, the net magnetising effect on the core is zero.

GRID SIGNAL

Now let us assume that, during the following instant, a positive-going signal reaches the grid of V1 and a negative-going signal reaches the grid of V2. (Our correspondent obviously understands that this would be so in such a circuit.)

In such a case, the plate current of V1 must swing upwards and increase its original magnetising effect on the core. This alone would be sufficient to induce a current in the secondary winding and produce some output from the loudspeaker.

However, the story doesn't end there. At the same instant, the plate current of V2 must swing downwards to decrease its magnetising effect and reduce that originally opposing the effect of V1.

Thus the decrease in the plate current of V2 supplements the effect of the increase in the plate current of V1, in respect to magnetisation in the core. As a result, extra output appears in the secondary winding.

On the reverse half-cycle, just the opposite conditions obtain. The plate current of V2 swings upward, while

To one and all . . . .

Merry Christmas

and a

Happy New Year

The Management and Staff of Ferguson Transformers Pty. Ltd. join in thanking you for your support in 1959, and look forward to the pleasure of serving you in the same spirit of friendly co-operation during the coming year.

FERGUSON

FERGUSON TRANSFORMERS PTY. LTD.

411 VICTORIA AVENUE, CHATSWOOD, N.S.W. JA8491

MELBOURNE—McKINNON NICHOLLS PTY. LTD.,
468 Collins St., MB1501.

ADELAIDE—TYQUIN LTD., 13 Deacon Ave., Richmond,
57-8153, 57-8154, 57-7887

BRISBANE—KEITH PERCY & CO., PTY. LTD.,
179 Elizabeth St., 2-1757

PERTH—ATHOL M. HILL, Durham House,
842 Hay St., 21-6987.

that of V1 swings downward, reversing the polarity of the current through the secondary winding and the loudspeaker voice coil.

It is possible to envisage the operation of the stage equally well in terms of voltage.

With zero instantaneous signal on the two grids, the plate currents are balanced and the same voltage drop occurs across each half of the output load. Therefore, the two plates are at the same potential and there is no net voltage difference across the transformer primary.

If we now assume a positive-going signal at the grid of V1, its plate current will increase and the extra voltage drop across the particular half of the secondary will reduce the plate voltage below normal.

At the same time, the negative going signal on the grid of V2 will decrease its plate current and allow the plate voltage to rise above normal.

UNBALANCED VOLTAGES

Therefore, the signal condition envisaged has caused a negative voltage swing at the plate of V1 and a positive voltage swing at the plate of V2. The two voltages are no longer balanced and, for the particular instant, the lower end of the transformer primary (as drawn) is more positive than the upper end.

On the succeeding half-cycle, the voltage swings the other way. This swing in voltage, to which both valves contribute, results in an equivalent swing in voltage across the secondary, which is duly impressed across the voice coil terminals of the loudspeaker.

Perhaps I should add that, in speaking of the voltage drop across each half of the transformer WITH SIGNAL, I am not just referring to the DC resistance of the winding. The voltage drop in question involves the impedance of the transformer and its output load.

So there it is, K.H. The output from the two valves does combine but, because it takes place in a centre-tapped load, they combine to produce an increased effective current change through that load, or an increased total voltage swing across it.

So, if you've been looking for some "mysterious" component it isn't the phase splitter or the output valves themselves. If anything, it would be the output transformer but, as you probably see by now, it isn't very mysterious either.

MENTAL PICTURE

Just one more point. When I first read your letter, an immediate mental picture came to mind from boyhood days in the country. I thought of two men using a cross-cut saw and the schermozzle which would result if they both insisted on pushing or pulling at the one time.

The operation is only possible because the operators tacitly agree to push and pull in turn. But then, do you really push a cross-cut saw?

Oh heck.

And here we must leave things for another month. Letters are still coming to hand about electric shock, about what occupies space and so on. As it happens, our immediate problem is that space right here is very much occupied and some of the letters have simply had to be held over.

Quality servicing and

STC BRIMAR VALVES

go hand in hand!

You can count on S.T.C. Brimar Valves to stay at a peak of performance long past the point where other valves decline. Make them standard for service replacements—you'll find their extra reliability will help maintain your reputation for quality radio and TV servicing

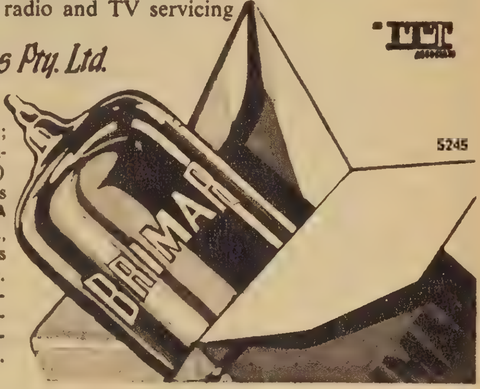
ITT

Standard Telephones and Cables Pty. Ltd.

DISTRIBUTORS

N.S.W. — S.T.C. Pty. Ltd., Sydney; Breville Wholesalers Pty. Ltd., Annandale. **QUEENSLAND** — S.T.C. (Qld.) Pty. Ltd., Brisbane; Trackson Brothers Pty. Ltd., Brisbane. **SOUTH AUSTRALIA** —Radio Electrical Wholesalers Ltd., Hindmarsh; Cornell Electronics Limited, 59 Hyde Street, Adelaide. **VICTORIA**—S.T.C. Pty. Ltd., Thornbury. **WEST AUSTRALIA**—M. J. Bateman Pty. Ltd., Perth. **TASMANIA**— W. & G. Genders Pty. Ltd., Hobart. Launceston, Burnie, Devonport.

5245



IS THIS YOU?

BE UP-TO-DATE
USE

PRONTO

SOLDERING GUN

NOW ALL IN ONE HAND

★ *Automatic Solder Feed.*

★ *Inbuilt Light.*

★ *Controlled heat for transistor soldering*

★ *Solder nib can be bent to any angle for difficult positions.*

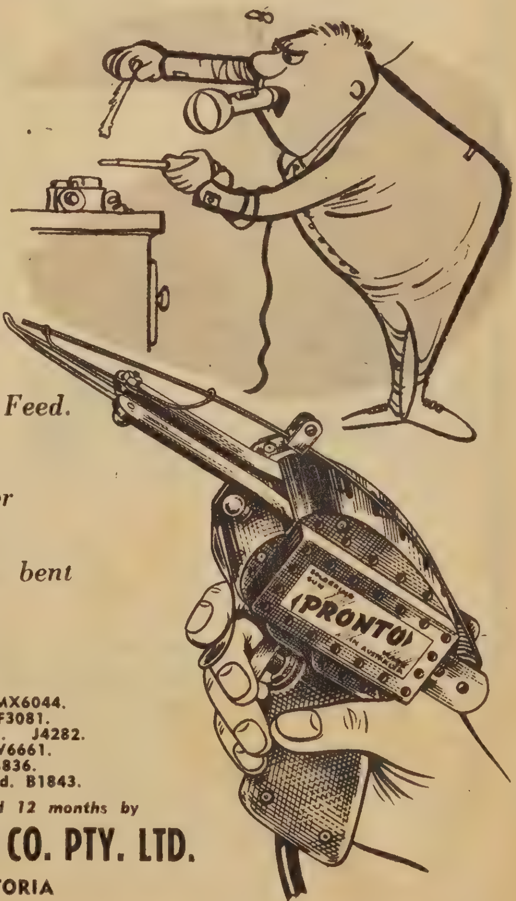
DISTRIBUTORS:

Vic.: E. W. Cornelius Pty. Ltd. MX6044.
N.S.W.: Reg J. Hymann & Co. JF3081.
Qld.: Raddon Enterprise Pty. Ltd. J4282.
S.A.: B. L. Shipway & Co. Ltd. W6661.
W.A.: C. L. Sedunary & Co. 67-3836.
Tas.: Associated Agencies Pty. Ltd. B1843.

Manufactured & Guaranteed 12 months by

TRANSFORMER MFG. CO. PTY. LTD.

FITZROY, VICTORIA



PLAYMASTER . . *hi-fidelity equipment*

STEREO 'and MONO'

A truly magnificent trio

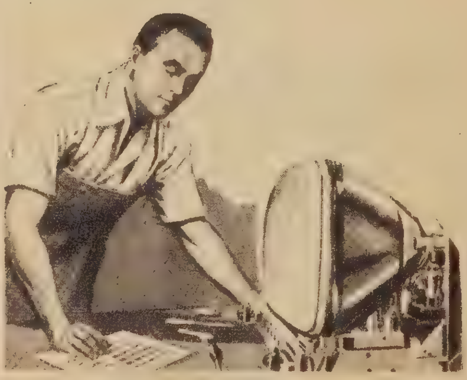
- ★ **The Playmaster 10 watt Amplifier (valves or silicon diodes—either version)**
- ★ **Playmaster Control Unit.**
- ★ **Playmaster. Program Source.**

For the discriminating, this Playmaster outfit is available either for stereophonic or monophonic reproduction, in kit form or ready built. Really true fidelity at extremely low cost.

We offer you a complete range of Playmaster amplifiers, control units and tuners, all faithfully to "R., T.V. & H." specifications and design

Send coupon below for your copy of the Playmaster catalogue and price list.

110° TV KIT . . .



Remarkable for its simplicity of layout and efficiency in operation, this is the very simplest possible TV set to build.

The kit is complete to the last nut and bolt. Everything is included, ready drilled chassis, picture tube, wired Q+ I.F. strip matched to Q+ tuner. A.W.A. deflection components and everything best quality, fully to "R.T.V. & H." specifications.

CABINETS. We offer you the choice of a high quality, fully veneered cabinet or a kit of parts to build your own.

LOW COST. The cost of the kit is amazingly low, and furthermore, we deliver free to capital cities.

Send Coupon or write for full details

TO ELECTRONIC PARTS PTY. LTD.,

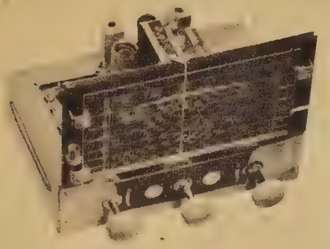
Dear Sirs,
Please send me full details of the following:
(mark square for information required)

☐ Playmaster Hi-Fi ☐ 110 deg. TV Kit

NAME ____________________

ADDRESS ____________________

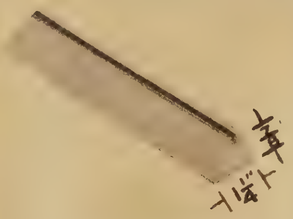
ELECTRONIC



Playmaster Dual Wave Tuner. Available with power supply and tuning indicator.

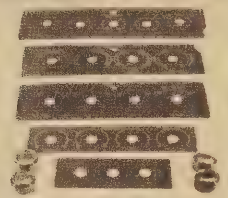
Playmaster control unit boxes, ready drilled complete with front panels and brackets. High quality, hammertone finish. Full range of Playmaster amplifier and tuner chasses also available.

Kits of parts available to make your own hi-fi equipment cabinet and 12in speaker enclosure. All panels precision cut from solid 7/8in selected timber.

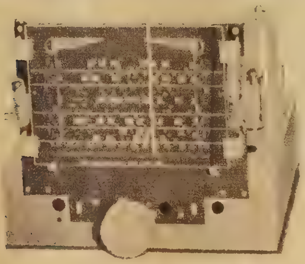


High-grade timber moulding, complete with gold coloured metal insert. Same type as used on highest quality TV cabinets.

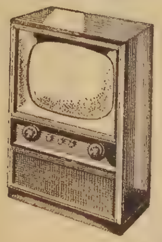
Complete kits plus ALL accessories and spares for the "R, TV and H" TV Sets and Playmaster Hi-fi equipment.



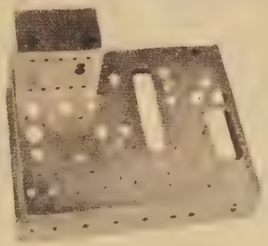
Anodised metal labels to suit various Playmaster amplifiers, control units, and program source. Mono' labels, maroon background with silver lettering. Stereo coffee brown and gold. Beautiful knobs with gold metal centres to match.



Some very fine hi-fi tuners are included in the Playmaster range. See Playmaster specification sheets for full details.



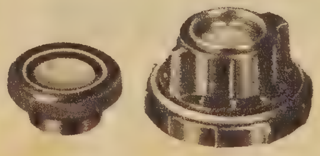
Timber kits to construct the 110 degree TV cabinet. Everything precision cut. All parts included, glass, mask, beading, gold insert, speaker grille, etc.



TV chassis, specially made for "R.T.V. and H." 110 degree circuit. Cadmium plated, and then passivated to avoid fingermarks. Complete with E.H.T. box, and all holes drilled.

The very best plastic TV masks as used on the finest commercial sets. 21in and 17in. Also available metal reducing mask, hammertone finish to enable 17in set to fit in 21in cabinet.

Q plus Mark V I.F. strip, ready wired and aligned for the 110 degree TV set. If purchased with the Q plus tuner, we will supply them matched.
For fringe areas Q plus Mark III and IV I.F. strips are available.



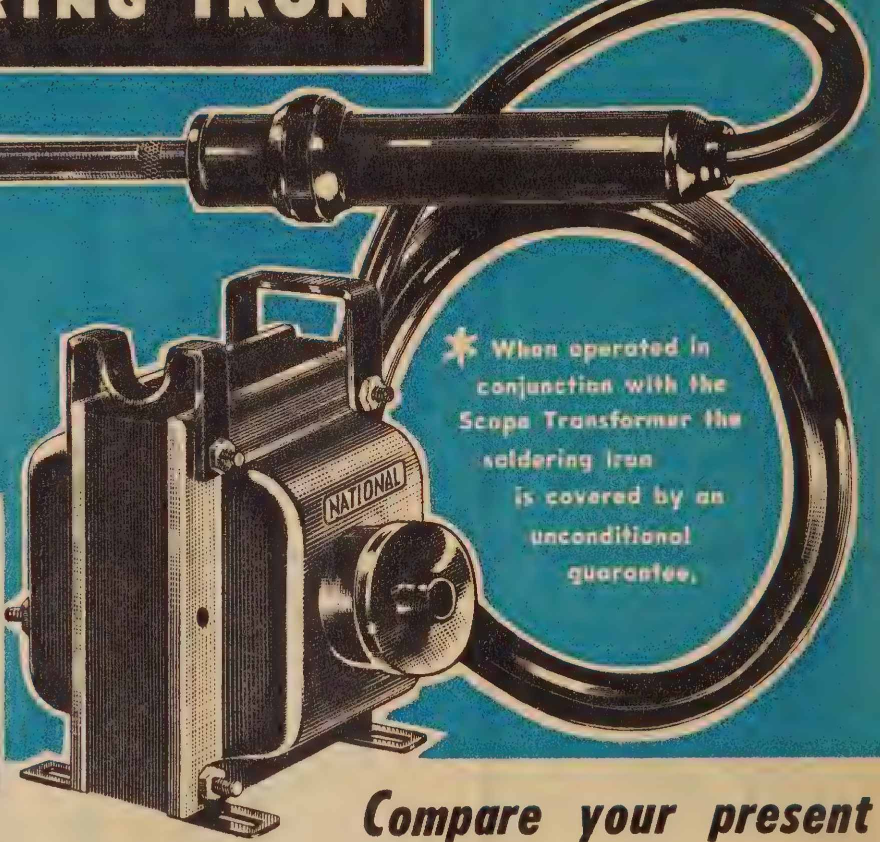
Set of 5 high-quality TV knobs for 110 degree TV set. In coffee brown or ivory, with attractive gold coloured, trim station numbers on tuning knob.

PARTS Pty. Ltd.

E. S. & A. BANK BUILDING, 206 BROADWAY, NSW
(opp. GRACE BROS.) PHONES BA4891, BA4892-3.

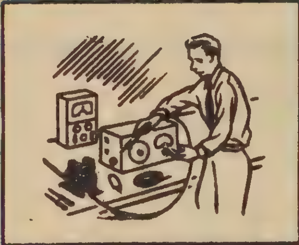
SCOPE
SOLDERING IRON

operates from car battery or AC mains (through Scope Transformer optionally supplied)



SCOPE LABORATORIES MELBOURNE

✱ When operated in conjunction with the Scope Transformer the soldering iron is covered by an unconditional guarantee.



IN THE WORKSHOP

FOR MOTORISTS

FOR SERVICEMEN

Compare your present iron with these Scope features!

- Absolutely safe—can be used with a transformer from AC Mains or from any suitable car battery.
- Weighs 3½oz and is 10in long.
- Heats up in 6 seconds—small tip localises heat, prevents damage to adjacent parts.
- Simple to operate—merely press switch ring forward — Switches off automatically when not in use.
- Extremely suitable for heavy or delicate soldering—equally efficient as irons rated up to 150 watts.
- No frequent cleaning or tinning of bit—parts are easily replaced and cost only a few pence.

ask your electrical supplier for a demonstration

RETAIL PRICES

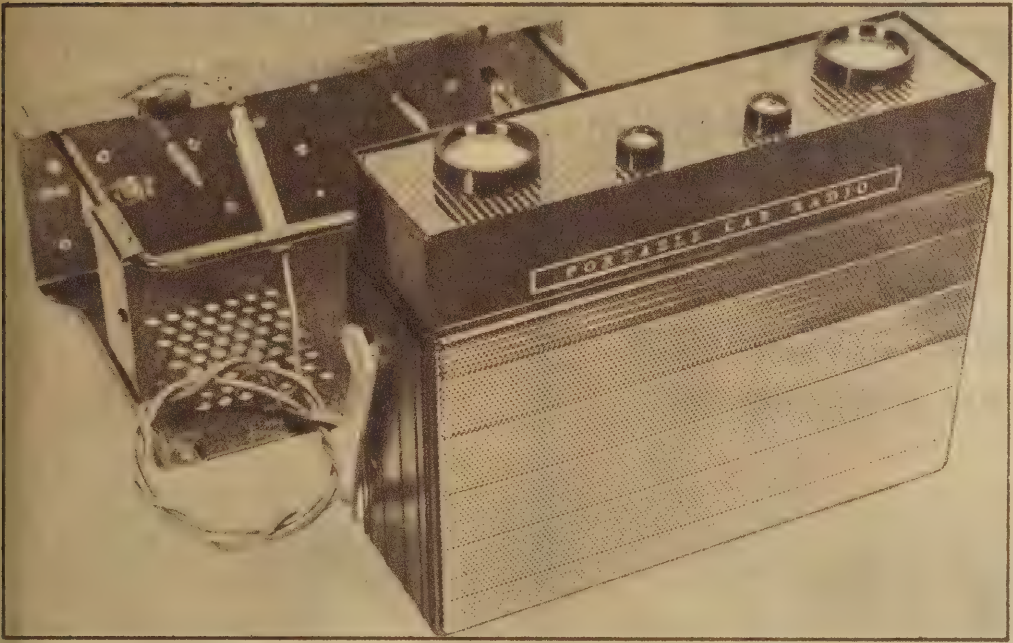
IRON 50/- TRANSFORMER 49/7

N.Z. Distributors: H. W. CLARKE
AUCKLAND AND WELLINGTON

Australian & Overseas Agents
WM. J. McLELLAN & CO. PTY. LTD.
126 Sussex St. (just North of King St.), Sydney. BX 1131
MANUFACTURED BY SCOPE LABORATORIES, MELBOURNE, VICTORIA

TRADE REVIEWS AND RELEASES

FIRST ALL-TRANSISTOR PORTABLE/CAR RADIO



The new Ferris portable-car radio and its cradle. Basic price of the set is 49 guineas, with cradle £4/19/- extra and car aerials from £2/12/6.

Claimed to be the first set of its kind manufactured in Australia, a new all-transistor portable/car radio receiver has just been announced by Ferris Bros. Pty. Ltd.

AS will be apparent from the photograph above, the set is basically a modern and stylish self-contained transistor portable. In this role, it boasts a more precise dial than is commonly provided in such receivers, together with volume and tone controls.

The basic finish is in glossy black, with gold-centred knobs and gold-finished grille and handle.

For use as a car radio, the receiver is held in a specially designed cradle, also shown in the photograph. This is fastened under the lip of the facia panel and wired permanently to the car's electrical system and to a regular car type aerial.

It is the work of a moment to slip the receiver into the cradle and lock it in position by looping the normal carrying handle over a lip on the underside of he cradle.

EASE OF FIXING

Sliding the set into the cradle automatically substitutes the car battery for he receiver's internal battery, connects he aerial and also makes available a onnection for whatever speaker system he design of the vehicle allows.

A knob on the receiver front panel elects the in-built ferrite rod aerial or he car aerial, as required.

The makers point out that, apart from moulding to enclose the dial mechanism and ferrite aerial, the remainder of he receiver is completely enclosed in etal. Thus, when switched for car adio use, with a separate aerial and inuilt aerial coil, the receiver is completely shielded and provided with the same filtering as an ordinary car radio.

Ignition problems are therefore minimised.

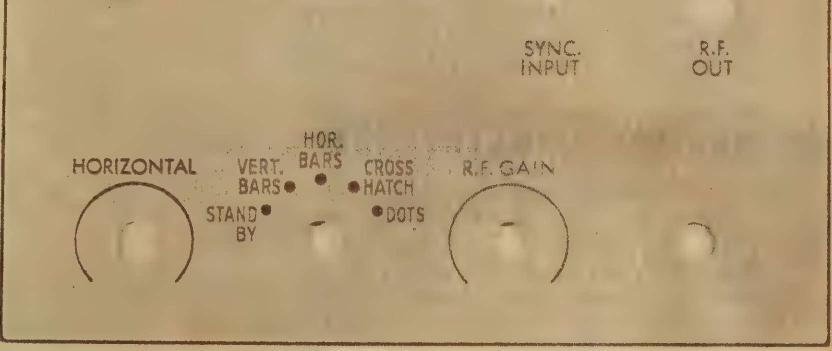
The receiver includes eight transistors in all — an RF amplifier, mixer, oscillator, I.F. amplifier, audio amplifier, driver and B-class output.

Demonstrated in a car, the receiver appeared to have ample gain and sensitivity, behaving much as one would expect of any ordinary car radio.

The only reservation is that the available audio power is less than from regular car receivers which means that it would have to operate at near full audio power in noisy conditions.

As a portable, its performance is extremely good, due in no small measure to the fact that it incorporates a 2N370 RF amplifier ahead of the mixer.

LABEL FOR PATTERN GENERATOR



If you have built the Simple Pattern Generator, or intend to build one, this label is available from Messrs. R. H. Oxford Pty. Ltd., Marriott and Telopea Sts., Redfern, N.S.W. (See article elsewhere in this issue).

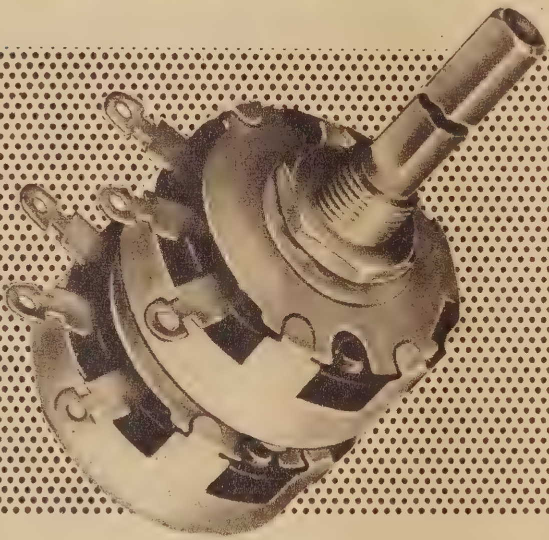
I.R.C.
AUSTRALIA

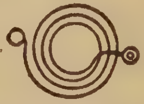
TYPE CS CONTROLS

Save you time and money on . . .

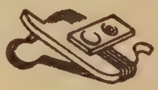
- **SERVICE CALLS**
- **ENGINEERING DEVELOPMENT**
- **LONG-TERM PERFORMANCE**

Only I.R.C. CS Controls incorporate Radio & TV's two most effective noise eliminating features!





SILENT SPIRAL CONNECTOR



MULTIPLE FINGER CONTACTOR

These features insure superior *NOISE FREE* performance under all operating conditions.

SILENT SPIRAL CONNECTOR

THE SILENT SPIRAL is the greatest single advance in volume control design the industry has known. This patented feature is exclusive to I.R.C. and it provides for permanently noiseless low resistance connection between the contact fingers as they move over the element and the centre terminal. The spiral replaces the conventional collector-ring method of connection which has been found to be the main generating source of rotational noise in other controls, due to the oxidisation of the moving metal contact surfaces.

MULTIPLE FINGER CONTACTOR

MULTIPLE FINGER CONTACTOR consists of five silver-plated phosphor-bronze springs which are independent of each other and have a "knee action" effect as they move over the element surface. The contact pressure of each spring is accurately adjusted to give correct pressure on the element for minimum noise level consistent with long life.

- *I.R.C. CS Controls are available in all standard values and tapers in plain, tapped, ganged and dual concentric combinations with or without DPST or SPST switches.*

ASK YOUR USUAL SUPPLIER FOR FULL DETAILS

Sole Australian Agents:

WM. J. McLELLAN & CO. PTY. LTD.

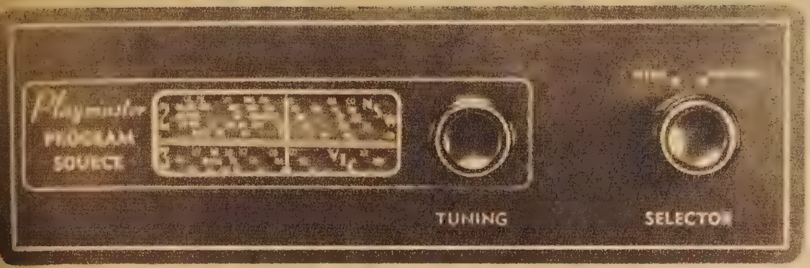
126 Sussex Street, Sydney. BX 1131

Victorian Agents:

AUSTRALASIAN ENGINEERING EQUIPMENT CO. PTY. LTD.

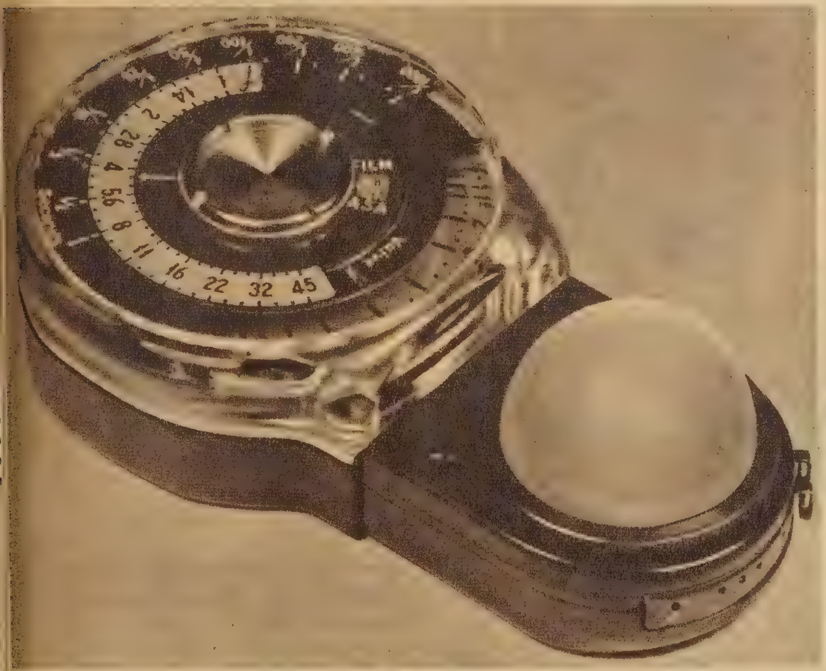
476 Latrobe St., Melbourne. FY 2638

PANEL FOR PLAYMASTER TUNER



ILLUSTRATED above is a front panel specifically produced for the Playmaster broadcast tuner featured last month and mentioned again in this issue. Styled to match the latest Control Units and designated as a "Program Source," the new unit should have an immediate appeal to readers who already have the basic amplifier equipment. The panel illustrated has a glossy anodised finish, reddish-brown in colour, and carries gold lines and lettering which combine well with the now-popular gold-centred control knobs. The tuner and control unit panels are available from Electronic Parts Pty. Ltd., 206 Broadway, Sydney.

EXPOSURE METER IS VERSATILE



Designated as the Walz Norwood Super Director, the exposure meter illustrated above is a very efficient and versatile instrument, which should appeal to advanced amateur and professional photographers alike.

'T has been designed primarily as an incident light meter, measuring the ght falling on the subject rather than ıe light reflected from it. It is generlly agreed that this method, where praccal, gives the more accurate exposure adings, for colour or reversal processes.

However, it can be used equally well a reflected light meter, where this ethod is preferred.

A feature of the instrument is the vivelling head, which allows the dial to read from either side or behind the c "seen" by the photocell. This minimises the risk of false readings due to trusion into the light zone.

The meter can be set up for semiıtomatic readings in that, given the necessary film data and exposure, it will read directly the required aperture.

The ranges covered are very wide. F numbers are calibrated from 1 to 22; ASA film speeds extend from 3 to 20,000; shutter speeds provided for range from 1/2000th second to 128 seconds; light value scale from 3 to 19.

For cine work, allowance can be made for a frame exposure rate of from 8 to 128 fps.

The Norwood Super Director is available through all leading photo stores and comes complete with case and reflected light attachment for £12/15/ retail. Trade inquiries to Camera Distributors Pty. Ltd., 85 Sussex Street, Sydney.

TEST EQUIPMENT AND AMPLIFIERS TO R. TV & H. DESIGN

STEREO

Mullard 2 Stereo chassis box in heavily plated dichromate steel, 40/ plus 25 p.c. S.T. Front plate printed with all graduations, 19/6. Stereo 2, wired and tested, £19/19/ plus 25 p.c. S.T.

R. and H. Low Input Stereo Preamp. Box heavily dichromated, 59/6, plus 25 p.c. S.T. Engraved front plate in burnished aluminium with dark red figures, 40/, plus 25 p.c. tax.

R. and H. 10 watt or 17 Watt Stereo chassis heavily dichromated, 45/, plus 25 p.c. tax.

R. and H. Stereo Radiogram chassis heavily dichromated, 45/, plus 25 p.c. tax.

TEST EQUIPMENT

R. and H. Sweep and Marker Generator case, all chassis printed front panel, £5/18/6, plus 12½ p.c. tax.

R. and H. Wide Band Scope case, all chassis printed front panel, £10/19/6, plus 12½ p.c. tax.

R. and H. Senior VTVM case chassis front panel printed, £4/13/6, plus 12½ p.c. tax.

R. and H. Bench type VTVM case chassis printed front panel, £2/14/, plus 12½ p.c. tax.

R. and H. Audio Signal Generator case chassis and printed front panel, £4/13/6, plus 12½ p.c. tax.

R. and H. RC Bridge case chassis and printed front panel, £3/4/6, plus 12½ p.c. tax.

R. and H. Audio Distortion Meter, case, chassis and printed front panel, £3/4/6, plus 12½ p.c. tax.

R. and H. Simple Pattern Generator, Case chassis and printed front panel, £3/4/6 plus 12½ p.c. tax.

Any of the above with Engraved front panel, £1/15/ extra.

TEST EQUIPMENT

FRONT PANELS

Engraved front panels for any of the above. 50/, plus 12½ p.c. tax; printed, 19/6, plus 12½ p.c. tax.

INSTRUMENT CASES

Finished in grey baked hammerdok.
R. and H. type, MC 5A 9 x 6 7/8 x 5½, 22/6, plus 12½ p.c. tax.
MC 82A, 13 x 8 x 6 7/8, 40/, plus 12½ p.c. tax.
SF 7A 7½ x 7¼ x 7¼ for bench type VTVM, 22/6, plus 12½ p.c. tax.

Cat. No.	Long	High	Deep	Price plus 12½ p.c. tax
MC 6	6	6	6	15/-
MC 7	10	8	7	22/6
MC 67	12	7	6	24/-
MC 81	10	10	8	29/-
MC 811	12	11	8	39/-
MC 79	15	9	7	50/-

SLOPING FRONT CASES

SF 7	7	6½	7¼	22/6
SF 79	9	6½	7¼	27/-
SF 71	11	6½	7¼	32/6
SF 8	13	8	8	39/-
SF 10	18	10	10	50/-

Chassis of 16-gauge Aluminium can be supplied for any of above, all prices plus postage, and slightly higher interstate.

MacKinnon and Nicholls Pty. Ltd.,
468 Collins St., Melbourne.
Martin de Launay, Newcastle.
Chandlers Pty. Ltd., Charlotte St.,
Brisbane.

R. H. Oxford & Son Pty. Ltd.

97 Marriott St., Redfern,
Sydney. MX3764.

The area shown on the right in white is the actual size of the amazing new Clarion tape recorder now available from Maxwell's Radio, 358 Lonsdale St., Melb. Also at Rundle's 146 Rundle St., Adelaide

7 STORES

MAXWELL'S

Famous for Fair Dealing since 1918!

MELBOURNE'S LEADING TAPE-RECORDER SPECIALISTS

proudly introduce the new ALL BRITISH

"CLARION *Transitape*"

MINIATURE TRANSISTOR TAPE-RECORDER

Maxwell's price only 48 gns. inc. mike £8 dep. 11/- wkly.

ACTUAL SIZE ONLY 9½in. x 5in. x 3-5/8in.

Now you can record **anywhere,** without need of electricity supply. This torch-battery operated Clarion goes with you on picnics and holidays . . . allows you to record in theatres . . . in your car . . . at functions and parties. It is ideal for recording radio musical programs for play-back at parties and any recording made on your Clarion can be played back on any other tape recorder. We have good stocks right now, but at this price they certainly won't last long, so don't delay—order by mail or phone **today,** or call personally as soon as possible at Maxwell's Radio for a no-obligation demonstration!

See the Clarion together with Australia's biggest selection of new and used tape recorders at —

Technical Specifications

● Size 9½in long, 5in wide, and 3 5/8in deep. ● Weight 5lb. ● Governed speed of 3¾in per second. ● Completely transistorised circuitry, powered by 4 torch batteries, giving 50 hours of playing time. ● Battery Voltage—6 volts. ● Tape running time—44 minutes. ● Can be used as a straight-thru' amplifier or a telephone amplifier —with or without recording. ● Can be used off a car battery.

MAXWELL'S

TAPE RECORDER CENTRE

358 LONSDALE ST., MELBOURNE. Phone MY1351.

OFF THE RECORD — NEWS & REVIEWS

The orchestra of the Suisse Romande is well an d favourably known to all record lovers, for it has made some of the most brilliant orchestral discs in the catalogue. Its home town is Geneva and its "home ground" is the Victoria Hall, only a stone's throw from my hotel here.

by John Moyle

Well, you'd need to throw very hard, but it's not very far away.

As with many other orchestras it holds quite a season of subscription concerts and these aren't the easiest of things to get into. The Victoria Hall is quite small, and although 150 seats are normally available each time to casuals, you have to be quicker off the mark than I am to be sure of a place any time you feel so inclined.

However, I have managed to make it, mainly by queueing up at the main doors like anyone else to see whether there are a few unsold seats.

These are not many when the star artists are on the bill and, because the Suisse Romande has a high reputation, there are plenty of well-known names amongst them.

Soon Ferenc Fricsay, Eugen Jochum and Paul Hindemith will be here.

Within a few days there have been Nathan Milstein who played the Tchaikowsky Concerto, Friedrich Gulda who played the Beethoven G major and Wilhelm Kempff who played the Schumann. Geza Anda is also scheduled to appear.

Kempff has just been to London where his concerts have received most enthusiastic reviews.

The orchestra travels quite a bit in Switzerland, and featured in a musical season at Montreux about 50 miles along the lake, and which was held earlier in the year. Just too far to reach!

PERMANENT CONDUCTOR

Ernest Ansermet is the permanent conductor and invariably conducts when recordings are being made. But during he year many guests conductors officiate.

During the course of a complete season you are liable to find almost anyone on the programme.

In passing, Yehudi Menuhin now lives n Switzerland, at a most picturesque ourist resort at the foot of the mounains called Gstaad (pronounced as far as I can make out Goostard). He has recently been joined by Milstein, so that Switzerland should never be short of ome good violinists, although lately I notice Menuhin hasn't been so well received in European concerts.

Menuhin takes an active interest in he local musical life and there seems o be much fine talent in this country.

Several small groups have had considrable success in concerts as far away as ondon.

The Victoria Hall itself is one of the most unusual I have ever been in. It is bviously named after Queen Victoria f Britain, for the Royal arms are prominently displayed in the decoration bove the proscenium, if it can be so alled.

In dimensions the hall is quite small. would imagine that it could be placed ompletely inside the Sydney Town Hall, r so my imagination led me to believe. is extraordinarily narrow with a ound floor which extends far below a ery deep main balcony, so that when eated against the very back of the wall, as I have been, one feels as though one were inside a deep cavern.

Along the sides of the hall are two tiers of balconies, so that although I don't know its exact capacity it would probably hold more than one would think.

Behind the orchestra there is a further batch of seats and two smaller balconies, no wider than the width of the main seat block on the floor, which gives it quite a curious appearance.

HEAVILY ORNAMENTED

The inside is profusely ornamented in heavy gold curlicues and swelling shapes, the ceiling also with a painted panel to finish it off. The gold is pretty shabby now, and the same goes for the dark red papered walls which carry a repetitive pattern.

When fresh in its new finish it would undoubtedly have been a most opulent little place, and even now, although I am frankly puzzled over many aspects of its design, it is rather fascinating in the manner in which it outdoes any product of Victorian times I have ever seen.

The balconies and heavy ornamentation have served to break up all the wall surfaces, and because of its size, when full it has no discernible lasting reverberation, so well is it damped.

As a result, I thought its acoustics were extremely good, in so far as everyone can hear, even in the back seats to which I have referred.

Altogether it is about the exact opposite in every way from Sydney's Hall, and this is the way it sounds.

You hear the music only once, not four times!

BRILLIANT PLAYING

This kind of hall is a "natural" for brilliant playing, and there is no doubt that it is here the Suisse Romande shines. I would hazard a guess that its records are made in this hall which makes a very good big studio.

I have heard numerous broadcasts from it, and they all have that sharp, rather dead quality one would expect from a smallish, heavily damped chamber.

This effect is heightened by the use of four separate microphones for broadcasting, again a contrast to the technique used in Australia.

Another reason why it does so well in brilliant and atmospheric music is that in Europe there is a good deal of new material played by young composers who seem to delight in such things.

In Gulda's concert this was a case in point.

make YOUR career in

TELEVISION

the

Australian Broadcasting Commission

has vacancies on the permanent staff in Sydney, Melbourne and Hobart for:—

SENIOR TECHNICIANS (£1110-1170 p.a.)
TECHNICIANS (£920-1050 p.a.)

Applicants should be qualified in Radio, Communications or Radar, with experience in the operation and maintenance of electronic equipment. Shift loadings and penalty rates for weekend work are payable in addition to the above salaries. There are excellent opportunities for advancement to more senior grades.

Apply NOW to the Director, Administrative Services
Box 487, G.P.O., Sydney.

8 IMPORTANT DESIGN IMPROVEMENTS IN NEW FERROGRAPH SERIES 4

This latest development of the incomparable Ferrograph incorporates several new design improvements and will enable every Series 4 Ferrograph to be readily adapted at any future time for a variety of applications. For example, space has been provided under the Head Cover to permit Head changes and additions for monitoring, stereo recording, stereo playback, dual track stereo to the new American standard or for lower track use. Such heads are designed to be plugged in and are fitted with rocking facilities for azimuth correction.

Also, this new development permits any Series 4A to be instantly converted to a Series 4S merely by plugging in the additional stereo head.

Other important design improvements are:

- The capstan motor is resiliently mounted for quiet operation.
- Function Switch Knob is re-fashioned for greater ease of operation.
- Brief Stop is now a standard fitting on all Ferrographs.
- The Head Cover—a one-piece moulding—is hinged for easy tape loading.
- The Turns Counter—now gear driven—is accurate to a turn.
- New standard colour scheme for all models—2-tone grey.

SERIES 4A
With standard monaural recording/playback facilities.
Model 4A/N 3¾/7½ i.p.s.
Price £239 2 6
Model 4A/H 7½/15 i.p.s.
Price £271 12 6

SERIES 88
With full stereophonic recording and playback facilities.
Model 88 7½/15 i.p.s.
Price £302 7 6

SERIES 4S
With optional stereo sound playback facilities in addition (when used with Stere-Ad Unit).
Model 4S/N 3¾/7½ i.p.s.
Price £268 0 9
Model 4S/H 7½/15 i.p.s.
Price £289 1 0
Stere-Ad Unit (when required) £90 9 0

PRICES QUOTED ARE RETAIL. TRADE PRICES EXTENDED TO BROADCASTING INTERESTS.

THE INCOMPARABLE **Ferrograph**

Demonstrations and supplies available from: **TAPE RECORDERS PTY. LTD.**
60 Clarence Street, Sydney. BX 1571

PLEASE WRITE TO US FOR FULL DESCRIPTIVE LITERATURE AND NAME OF YOUR NEAREST DISTRIBUTOR AND SERVICE AGENT

The strings first played the Vivaldi :oncerto Opus 3 No. 8 quite exquisitely ind cleanly. The Beethoven G major vhich followed just wasn't in the same :lass—there was no real stature to it, or in my view neither orchestra nor ianist succeeded in thinking through he score as should be done.

Gulda's brilliance is undoubted—his echnique and ability are no accident—ut it was in the second half that the rchestra really showed its form.

Two of the works were first performnces — "Marsia," Suite du Ballet by .uigi Dallapiccola and Sonata Titematica Jo. 3 by Luciano Chailly.

'HREE "IDEAS"

This latter is something which our wn orchestra would do well to acquire possible, for I am sure it would be opular. It is built on three "ideas" intead of the traditional two, and is workd out as far as I could follow in stanard sonata form with great skill, musiianship and imagination.

As the conductor was a young Italian, ianfranco Rivoli, everything was in ivour of first-rate performance.

The final number, Prokofieff's Scythn Suite was another ideally suited to ie conditions and the occasion.

Nor did the unusual program frighten iyone away, for the place was packed.

On October 28 there is a special con:rt arranged by the Ville de Geneve and adio-Geneve in honour of the I.T.U. nference to which invitations have en sent to all who are taking part. As ese number well over 1,000 people it ould be an occasion. France Clidat the pianist in the Grieg Concerto and irique Jorda will conduct the Suisse mande.

The Swiss are very proud of their orestra, and they have good reason.

Another interesting musical centre I ited in recent weeks is Munich, which only about 1½ hours by air from neva.

It is rather a depressing city in many ys, for war damage is most severe, d a great part of the city and its hisic buildings were destroyed. This indes the opera house which is temporly in business at the Bayerische Staatsatre, about 40 minutes walk from the itself.

VO PERFORMANCES

Iere I saw two performances, one of lelio by Beethoven, and the other of Bartered Bride by Smetana.

This theatre obviously bears little reiblance to the completely ruined era House, of which only the walls stand, but it has been worked over h a new salon and its facilities are te good.

lut the hard wooden seats are a test a stoic!

Iere the standard of performance was high, and many well-known singers ilarly appear, some of them resid- of Munich. But it is not surprising results do not compare with those Vienna.

he Bartered Bride proves to be alt hilarious on the stage, and the final ies, which include a performing pe, starred a couple of clowns who ld have won a place in any show.

he best singing was in Fidelio, which ist as well for, from a stage point of '. it hasn't much to commend it.

eonore was sung by Inge Borkh with a fine voice and an equally stunning appearance.

At the end she received a tremendous ovation. So great was the applause, which continued after the safety curtain had been lowered, that her last bow was taken through a small door which opened in it!

It was nearly 15 minutes before the audience completely left the theatre.

But it is fairly plain that Beethoven had little idea about how his opera would look on the stage. The story is the rankest sentimental melodrama in which the characters had little to do but stand about and sing, but they did justice to some magnificent music which maybe is the main thing.

The conductor was Joseph Keilberth, another familiar name in the recording world.

But my main purpose in going to Munich was to visit Salzburg, which, by fast train, is less than two hours away at the foot of the Austrian Alps, and almost under the shadow of Berchtesgaden, about which even the guide books have little to say.

The Austrians will make the point that they were an occupied country during the last war, and had little say in the progress of events.

Salzburg musically is virtually devoted to Mozart but many other musicians of later years have lived and composed works there.

MUSEUM HOUSE

The house in which he was born in Getreidgasse has been converted into a museum, although there is an even larger one down by the river Salzach.

The house consists of three rooms, in the centre one of which Mozart's cradle allegedly stood. In this room is his piano built in Vienna about 1780 and his clavichord with double stringing built about 1760.

In showcases there are many other mementoes of the composer, some of his manuscripts including some early counterpoint exercises with sums in arithmetic scribbled over them, his diploma certifying entry by examination to the Bologna Academy at the age of 14, the first movement manuscript of the Paris Symphony and locks of brown, glossy hair.

The city itself is not large, but must be one of the loveliest in Europe, even more so on a warm, sunny day, with the trees in the parks and on the surrounding hills breaking into autumn colours.

This isn't a travelogue, but I won't soon forget my visit to Salzburg.

STATE ASSISTANCE

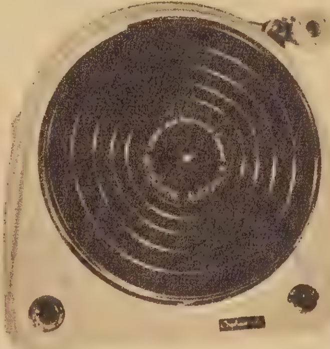
As a final note, here is an extract from a London paper on a subject well worn all over the world. It is notable for the figures it gives on State assistance to orchestras in Europe, and has a direct bearing on the wealth of music I have been describing. I came across it the other day in the "Daily Telegraph."

After deploring the poor attendances at concerts which do not feature well-known works Martin Cooper says—

The situation would be comic if the numbers of these self-restricted music-lovers were not large enough to give them an important, though passive part in determining what music can, from the economic point of view, be presented in London. In fact it is the public that pays the piper and can therefore call the tune;

Man! What A Turntable!

The Answer To The HI-FI Man's Dream



£37/14/8 Retail Price

THE ORPHEUS "SILEX" 4-SPEED TURNTABLE

- The only reasonably priced turntable guaranteed to be completely silent.
- The only turntable to incorporate pick-up mount and turntable-support bearings as one isolated system.
- The only turntable designed with a pick-up mounting system adjustable in vertical height as well as in horizontal plane.
- Total wow and flutter 0.09 per cent at 33 1/3 r.p.m.
- Hardened, ground and polished spindle virtually indestructible by wear.
- 16 2/3, 33 1/3, 45, 78 r.p.m. with 7 per cent speed adjustment on a single control.

USE THE ORPHEUS "SILEX" TURNTABLE WITH THE M.B.H. (HARRIS) "EQUIDYNE" Pick-up Arm principle and your Monaural-Stereo problems are solved for a long time to come.

The "Equidyne" Pick-up Principle incorporates the only side-pressure balancing system in the world, reducing stylus wear by three to four times.

WRITE FOR BROCHURE AND PRICE LIST.

"The House of Quality Products"

WILLIAM WILLIS & CO. PTY. LTD.

428 Bourke Street, Melbourne, C1

Phone MU 2426

T-E-R-R-I-F-I-C !

NEVER BEFORE SUCH HIGH-PRICE FEATURES AT SUCH LOW, LOW COST

TWO NEW PHILIPS TAPE RECORDERS!

fully equipped for sound-mixing, monitoring and superb high fidelity

Put these two new tape recorders through their paces and you'll recognise their performance as outstanding — their price outstanding value! With either single or three-speed models you can record speech or music with crystal-clear, high-fidelity brilliance. You can make your own sound tracks for home movies; you can monitor during recording. You can tape a recording up to six hours long and, at any stage, you only need to press a button to play back, pause, part-wind backwards or forwards.

- A new Philips recording playback head reduces the width of recording slit to .0002 of an inch, a fraction of the width of a human hair, bringing true high fidelity to all recording and reproduction even at the speed of 3¾ inches per second.
- Separate volume controls for mixing input from mike and player or radio with professional quality.
- "Piano Key" pushbutton operation wholly automatic and trouble-free.
- Friction Brakes • Safety lock prevents accidental erasure.
- Big 7" reels—long playing • Facilities for dictation, conference recording, public address • Many other features.

AT YOUR PHILIPS RETAILER

PHILIPS

Be sure it's a **PHILIPS**

ER 1500 A

Three Speed "Professional Fidelity" Model 149 gns.

EL 3515 A

Single Speed 3¾" per second "High fidelity" Model 99 gns.

and any attempt to improve the programs of our orchestral concerts must start from a recognition of this fact.

What must be reformed is either the public taste or the system by which concerts depend entirely on public support n the form of box-office sales.

The situation in other countries suggets that the two are linked. If public aste in France and Germany is more dventurous, this is partly because that aste has been formed over the years by programs including fresh music which, by repetition, has become familiar.

LARGE SUBSIDIES

These programs themselves have been made possible only by the existence of arge State or municipal subsidies, such as we can hardly imagine here. Let us ook for a moment at some figures.

In Germany most orchestras receive wo subsidies, one from the municipality and the other from the region, or Land, concerned. In the case of Berlin the wo sources are identical and the Berlin Philharmonic therefore receives a total rant of DM 1,500,000 (well over £125,000). The Berlin Radio Symphony Orchestra's subsidy is made up rom a number of sources—two broadcasting stations (DM 1,000,000), the Deutsche Grammofon Gesellschaft (DM 70,000), the municipality and Land 250,000) and the Federal Government 250,000). This makes a total of DM 1,570,000, or well over £130,000.

Munich, where Land and municipality are again identical, subsidises the Bavarian Radio Symphony Orchestra at the ate of DM 1,590,000, or £132,000, per annum. In France the latest published igure for Government subsidies to the Societe des Concerts du Conservatoire and the Associations Symphoniques is 22 million francs or more than £16,000, while the Opera and the Opera Comique between them received 1,485,250,000 rancs, or £1,014,000. This is comparable to the Austrian State subsidies o the Vienna Opera and Volksoper, which between them amount to some 30 million schillings, or nearly £1,750,000.

How do these figure compare with the Treasury's grant to the arts in this country through the Arts Council? The latest published total is given as £1,100,000, for the year ended in March, 1959. Since music is only one art, this sum has to be shared with the theatre and the visual arts. Covent Garden has received £362,000 and Sadler's Wells £155,000 of this, and the shares of the chief subsidised orchestras have been as follows: London Symphony. £4,000; London Philharmonic, £12,000; Halle, £15,000; Royal Liverpool, £20,000; City of Birmingham, £20,000; Bournemouth, £20,000. In the case of the L.P.O. and the provincial orchestras there are also municipal subsidies: Bournemouth gives £500 and the L.C.C. £3,795.

VITAL POINT

The first thing that emerges from these figures is the astonishing fact that Berlin can spend on its orchestras and Vienna and Paris on their operas more money in a year than this country devotes to all the arts together.

Money is by no means everything in the arts, but without it there can be no expansion, no boldness in planning and no taking of risks. Our concert-programs reflect the cautiousness which the ordinary man must exercise when gambling with uncertain quantities.

HOPELESS TASK

How can the private individual and the orchestra with a subsidy of less than £20,000 show the same enterprise as a body with an officially guaranteed income of five or six times that amount? English audiences get the music, not that they deserve, but that reflects the value attached to the arts by the nation as a whole.

Nor does this anomaly remain hidden from the rest of the world. Australia and New Zealand have for long been clamouring for a visit from one of our leading orchestras, but none has been able even to consider the expense involved. It has remained for the Czech Philharmonic to step into the gap—heavily subsidised, of course, by the Czech Government.

RECORD REVIEWS:—

FRANCK — Symphony in D Minor played by the Boston Symphony Orchestra conducted by Charles Munch. RCA SL16116 (Stereo).

A performance in which the virtues f the symphony have been preserved d its pitfalls avoided.

I liked the way in which Munch sets e mood in the graduated cadence of e opening bars. It is here that the usic stands or falls — we know when e hear it what we are in for. Munch ows his hand and lays the foundation r a firm outline which he never loses r a moment.

He catches all the traditional nature Franck — his gentleness, his mystism, his organ-like progressions and gistrations.

He picks his way through them with sure footing, never losing his way, ear of any distractions, avoiding the multiplicity of full stops with which the music can easily be punctuated, balancing each episode against the next, and against those to come.

He has mastered the art of keeping the symphony moving without obvious hurry or loss of line.

In fact, the second and third movements are played quite briskly, but he has timed his tempos so well that we are not over-conscious of it.

These things have produced the most satisfactory version musically to be had.

The stereo is not particularly prominent, mainly because it has been used to build and consolidate the body of sound, but also because there is very little scope for instrumental placement except in groups which do not naturally place themselves at a point source.

Thus its value is not immediately obvious, until one experiments by playing both channels through one speaker. The

For the finest results in sound

PHILIPS Magnetic Tape

Expert audiophiles specify Philips tape because of its superior recording characteristics and "Full Dynamic" range. Greater sensitivity captures high notes with perfect fidelity, while noise level stays low. Philips Magnetic tape is highly resistant to snapping and tearing; built-in lubrication prevents recording head wear; moistureproof and unaffected by tropical conditions, Philips Magnetic Tapes do not wrinkle or stretch. They are produced to international standards and suitable for all tape recorders.

TYPE NUMBER	REEL SIZE	FOOTAGE
RE 957	7" (long play)	1,700 ft.
EL 3915/5	5" (long play)	850 ft.
EL 3908/50	4" (long play)	400 ft.
EL 3953/60	3" (long play)	200 ft.

Empty reels available in all sizes

For special applications.
ER1600 Super-Synchro-cine Tape (special magnetic tape for synchronous home movies and slides) contains 720 feet of long play tape on 5" reel, with mirror and instructions.

Be sure it's a

PHILIPS

P1727-59

CHRISTMAS GREETINGS

The Directors and Staff of

TRIMAX TRANSFORMERS PTY. LTD.

CNR. WILLIAMS RD. AND CHARLES ST.,
NORTH COBURG, VICTORIA.

wish you the Compliments of the Season!

IMPORTANT!

As well as our well-known range of Transformers, Chokes, Electronic Equipment and Accessories . . .

TRIMAX
NOW manufactures

SOLENOIDS
for the Electrical Industry

IGNITION TRANSFORMERS
for oil or gas furnaces

IGNITION COILS
for flywheel magnetos

and above all

AUDIO ENGINEERS
remember our

- **FADERS and**
- **GAIN CONTROLS**

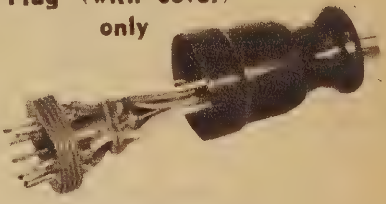
manufactured to the high standard already set by other TRIMAX PRODUCTS.

TRIMAX TRANSFORMERS

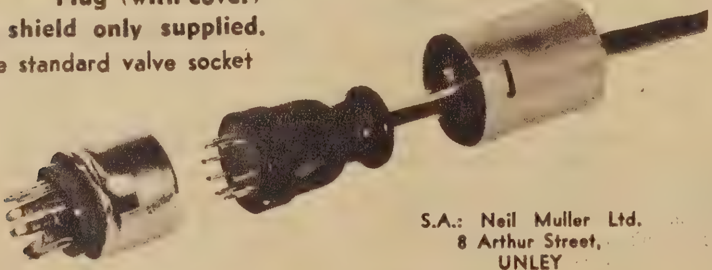
NINE PIN NOVAL PLUG

Shielded

Plug (with cover) only



Plug (with cover) and shield only supplied. Use standard valve socket



Fits standard 9 pin valve socket. Pins silver plated. NOTE Lashing Bollard.

N.S.W.: Jacoby, Mitchell & Co. Pty. Ltd.,
469 Kent Street,
SYDNEY

S.A.: Neil Muller Ltd.
8 Arthur Street,
UNLEY

TAS.: Homecrafts (Tas.) Pty. Ltd.,
220 Elizabeth Street,
HOBART

W.A.: D. K. Northover & Co.
115 Murray Street,
PERTH

available from all leading wholesaler
and radio parts suppliers

Manufactured by . . .
ZEPHYR PRODUCTS PTY. LTD., 58 HIGH STREET, GLEN IRIS, S.E.6., VIC.
TELEPHONE: BL1300, BL4556.

reduction in size and atmosphere is most marked if you care to try.

The recording is very good, but there is a hint of stress in the heavy passages, and a slight tendency to break-up in the extreme tops, particularly at the end of the second side.

The bass is convincing, solid and well sustained in the long passages to give weight and strength.

The surface, except for one or two small spots, is very good, and virtually inaudible in the quiet passages where its absence is most vital.

* * *

LISZT — Hungarian Rhapsodies Nos. 1 and 2. GRIEG — Peer Gynt Suites Nos. 1 and 2. Played by the Bamberg Symphony Orchestra conducted by Richard Kraus. DGG 136020 ST33 SLPM.

This is a concert hall type of recording. It sounds as though the microphones have been strategically placed in quite a lage auditorium, giving the sound all the quality of a performance.

This shows up clearly on the louder passages where there is noticeable echo and reverberation which, although it does not make for the clearest sound, at least is a pretty good estimate of what it must have been like to a listener there.

Otherwise the definition is very good, and there are no troubles about balance.

What I did like was the ease with which it was possible to place the instruments both in spread and depth.

It was quite evident that the orthodox orchestral placement has been used, with the violins at the left, cellos and bass to the right, and woodwinds, brass, etc., in the centre.

And let no one tell you that the ower strings are not easy to locate. I at east had no trouble in placing them.

But this is no gimmick disc. It is downright musical stereo and I am all for quality of this kind.

It completely frees one from the impression that there are any loudspeakers at work.

Altogether it's a disc with an unusual mount of good stuff, not heavily cut out with good frequency range and some brilliant moments.

The orchestra is particularly neat and well-behaved rather than glamorous or pectacular.

And the recording reveals smooth rings, very fine and relaxed brass, and ass instruments a little understated but gain well in balance with the remainder.

All the items are well played. The eer Gynt hasn't quite the Beecham much, being much more straightforward its statement. But like the Liszt it essentially musical and I liked it very much.

The only flaw was a surface which ecame unpredictably obvious now and en, most unusual for DGG.

* * *

HAVANA IN HI-FI — Rhapsodero, My Hopeful Heart, Cordoba, Topical Merengue, Maria - la - o, Caminto, La Comparsa, I Won't Stand In Your Way, and Love And The World Loves With You. Played by Richard Hayman and Orchestra. Mercury SR 60,000 (Stereo).

The recording is clean and vivid, the rangements are varied and colourful, e stereo of its kind is first rate.

I don't know whether we are meant to ce the Cuban slant too literally, although Lecuona is given as the source for most of the items, and the rhythm and atmosphere is suitable to the name.

It was recorded, we are told, in a very large studio with two U47 Telefunkens 15ft high and 12in apart, apparently with suitable regard to their polar diagrams.

The result is very lively sound which has good presence but which is obviously not of the mike - hugging type.

The reverberation is not normally noticeable as such, although there is quite a bit of it in the background to hold up the sound at the end of a phrase, and it has obviously been a useful asset.

Separation is most marked and has been used to highlight and contrast strings, brass, marimbas, guitars and so on which makes it quite striking to hear.

Nor is there a continued search for brazen sound which is chased into monotony all too often in discs like this. It is therefore not as brilliant as the super productions, but in its way more interesting than many.

The cutting amplitude is very high and variable spacing has avoided any sign of groove echo. This high amplitude, coupled with a surface almost completely quiet for the most part, means that the music plays largely from dead silence.

This is a good one. The music must always rate high where the spectacular quality of stereo is exploited.

* * *

SCHUBERT—Symphony No. 9 in C Major. Played by the London Symphony Orchestra conducted by Josef Krips. Decca LXT 5471.

As the jacket notes so aptly put it, a poor performance of the Schubert Ninth can appear to drag its length upon the ground.

And it often does.

Even with a good performance, my enjoyment often bears a direct relationship to the amount of time I have to spare.

For no matter how lovely the material there comes a time when most men feel they have had enough for the moment.

It is obvious that Schubert himself never felt that way, and that's one reason it seems so infernally rude and ungenerous to question his ideas of delight.

Josef Krips, who is another disarming personality, and might be considered to have some matters in common with Schubert, is extremely successful in persuading us that the symphony, despite its undoubted length, is not a note too long.

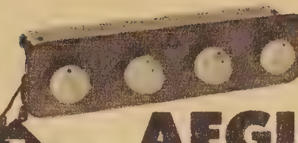
He and his orchestra have brought out possibly the best all-round version so far, a well-built version, one with relaxation and purpose.

There are no dead sections to sprawl and tire us. The speeds are brisk but not fast and there is much well-judged dynamic variation to keep us interested.

Not a little of the success of this disc is due to the recording itself. It has very good balance and clarity, something which I for one appreciated very much, for I have heard many Ninths which degenerated into a distressing tubbiness and turgid amalgam particularly in the middle sections.

This one is airy without being over-reverberant and the orchestra has plenty of size. The bass is firm, but I'd like to have heard just a little bit more of it.

There are several recordings of this symphony which have their own appeals



AEGIS
STEREOPHONIC
& HI-FIDELITY UNITS

Australia's Own Brand from leading Australia - wide dealers!

AEGIS Ultra-Linear Basic 5/10 Amplifier £40/5/
AEGIS Standard Control Unit £7/17/6
AEGIS Stereophonic Coupling Unit (illus.) £17/15/
AEGIS Pre-amplifier Mark 1 .... £21/17/6
AEGIS Pre-amplifier Mark 2 ...... £26/15/6
AEGIS Fidelity Radio Tuner Mark 1 .... £35
AEGIS Fidelity Radio Tuner Mark 2 .... £32/17/6
(Capital City Prices)

If unobtainable locally, write direct to . . .

AEGIS MFG. CO. PTY. LTD.
208 Lt. Lonsdale St., Melb. FB3731.

AWA RONETTE
MICROPHONES & ACCESSORIES

Type 44
PRICE
£3/19/-
Hand or desk mounting, counter-balanced base, ivory plastic housing.

NEWTON McLAREN
17 LEIGH ST., ADELAIDE.
and leading wholesalers

CHRISTMAS SPECIAL
MODULATED OSCILLATORS, NEW
120Kc—25 Mcs
Direct Callibration Dial. Enclosed in smart Black Brocade metal cabinet.
Only £17/10/- f.o.r.
These Units are a Scoop Purchase from well-known manufacturer.

WANTED TO PURCHASE
Test Equip., Communication Receivers, Transceivers etc.

Paragon Radio
479 Parramatta Rd., Leichhardt
(top Taveners Hill) Phone LM9402.

Do You Laugh Your Greatest Powers Away?

THOSE STRANGE INNER URGES

You have heard the phrase, "Laugh, clown, laugh." Well, that fits me perfectly. I'd fret, worry and try to reason my way out of difficulties—all to no avail; then I'd have a hunch, a something within that would tell me to do a certain thing. I'd laugh it off with a shrug. I knew too much, I thought, to heed these impressions. Well, it's different now—I've learned to use this inner power and I no longer make the mistakes I did because I do the right thing at the right time.

This FREE BOOK Will Prove What Your Mind Can Do!

Here is how I got started right. I had heard about hypnosis revealing past lives. I began to think there must be some inner intelligence with which we were born. In fact, I often heard it said there was; but how could I use it, how could I make it work for me daily? That was my problem. I wanted to learn to direct this inner voice. master it if I could. Finally, I wrote to the Rosicrucians, a world-wide fraternity of progressive men and women, who offered to send me, without obligation, a free book entitled "The Mastery of Life."

That book opened a new world to me. I advise *you* to write to-day and ask for your copy. *It will prove to you* what your mind can

demonstrate. Don't go through life laughing your mental powers away. Use the coupon below or write: Scribe K G.L.

USE THIS GIFT COUPON

SCRIBE K. G. L.
The Rosicrucians (AMORC)
Box 3988, G.P.O., Sydney, Australia.

Please send free copy of *The Mastery of Life*, which I shall read as directed.

Name ....

Address..........

City ....State..........

The ROSICRUCIANS (AMORC), Box 3988, G.P.O., Sydney, Australia

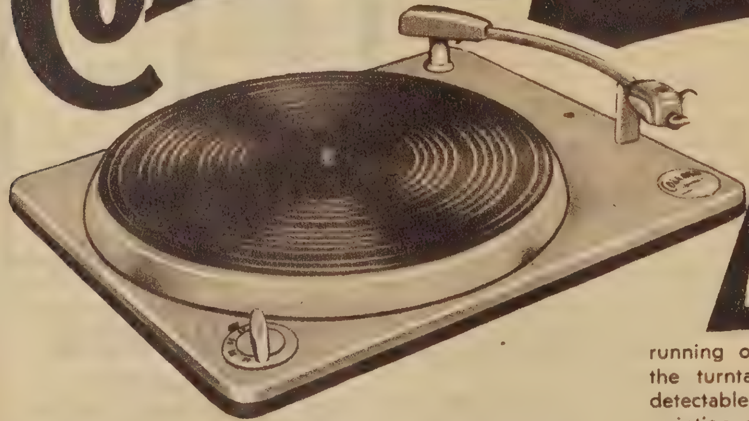
---

COLLARO

For Fidelity Reproduction in Studio or Home!

4-SPEED TRANSCRIPTION UNIT

Also available in STEREO



Here's an entirely new type 4-speed mechanism ensuring absolutely uniform speed with reproduction free from frequency modulation. The heavy turntable is fitted with a ground and lapped spindle running on a ball which takes the total thrust of the turntable, resulting in correct speed with no detectable "wow" or "rumble". The 'Studio' transcription arm is of tubular metal which has a very low resonance and is so designed as to be capable of playing 16" discs. Any type of 'Studio' turnover crystal cartridge can be fitted — including stereo heads.

NEVER BEFORE SUCH HIGH QUALITY — AT SUCH A LOW COST

Sole Australian Distributors:

ELECTRONIC INDUSTRIES IMPORTS PTY. LTD.

VIC.
139-143 Bouverie St.
Carlton. Telephone 34-4161

N.S.W.
121 Crown St.
East Sydney. FA 0531

S.A.
90 Grote St.
Adelaide. LA 5295-6-7-8

QLD.
376 Ann St.
Brisbane. 2-6462

W.A.
68a Railway Pde.
West Perth. 28-311

—there is one by Toscanini and another by Furtwangler I call to mind—but if I had to choose the best all-round record for you, I'd be sorely tempted by this fine disc.

* * *

BEETHOVEN—Sonata No. 3 in E flat Opus 12 No. 2; BRAHMS—Sonata No. 3 in D Minor Opus 103. Played by David Oistrakh and Vladimir Yampolski. Columbia 330CX 1580.

All who heard these two during their concerts in Australia — and most who will be interested in this record did — will know what to expect.

I for one can remember almost every moment in the Brahms. This performance reproduces exactly the one I heard in Sydney. It was almost uncanny how accurately it brought back features of the performance, both those I did and did not like.

By accident or design, Oistrakh, as usual, is the star. In fact, most of the time it's hard to hear anything else but him.

His powerful bowing is extremely forward, but his pianist is by comparison so far back in the studio as to have completely different acoustics.

It would have been a much better balance to have evened them up, and I think the performance would have gained thereby, particularly in the Beethoven, where a sizeable portion of the violin part is not melodically endearing.

In the Brahms, although the violin is erhaps even more forward, this is not uch a disadvantage in this respect, but t has made Oistrakh sound more heavy anded than he really is.

At times he is quite overpowering, and n alteration to the volume control is ot a palliative—it is more a matter of ver-close mike technique which projects he violin so forcibly.

At the same time, Oistrakh is that kind f a violinist. His romanticism, even when it is touched most lightly, has trong colours, whereas I don't think the motional pressure is quite so unremitting in this sonata.

Otherwise there is a great deal of magificent and lofty playing on both sides, laying with such dignity and authority hat its place in the top class is automatic.

The presence of the violin is such that ou may think its edge better for some oftening, but personally I think that's he way it sounded. The engineers have one their part well. Even now I can't emember whether there was any surface oise or not, so I guess it must be pretty ood at that.

It's potent playing of two fine works.

* * *

TCHAIKOWSKY — Capriccio Italien Opus 45. Played by the London Symphony Orchestra conducted by Anthony Collins. Decca CEP 541.

A lusty and flashy performance of a ork in which these qualities are more aluable than any others.

It crashes and bangs its way to a umultuous finale with special attention the instruments concerned, surely rger than life but doing their duty bly all the same.

Engineering rises to the occasion, though I liked it best with the top lled off a little.

The surface is adequate, and the cutng amplitude quite high. A good, inpensive version of a popular work.

L. B. PRODUCTS
STEREO TAPE HEADS!!
NOW AVAILABLE!!

These Heads consist of a matched pair of stacked half track record-play elements within the one standard case.
Pre-aligned, in-line gaps of extreme accuracy (.00016 in. gap spacers, alignment is so exact that the outputs of both tracks are fully in phase up to 20 kc.)
Cross-talk is better than—43 dB.

TWO INCOMPARABLE MODELS:—

TYPE DT Extended range, high impedance, low impedance bias. Physically and electrically interchangeable with Ultron 15T, each track giving the same performance as Ultron 15T.
TYPE DH Extreme range, medium impedance, low impedance bias. Physically and electrically interchangeable with Ultron 15HT, each track giving the same performance as Ultron 15HT.

THESE HEADS ARE BUILT TO THE SAME HIGH STANDARDS THAT HAVE MADE L.B. PRODUCTS TAPE HEADS LEADERS IN THE FIELD FOR A DECADE

Used by Govt. Depts., Universities, Research Depts., Tape Recorder Manufacturers, Telephone Companies, etc., and are fully guaranteed for one year.

RETAIL PRICE LIST

Type DT and DH (Stereo	£17/12/
Ultron 15, 15T, 15L (Record-play high impedance, extra range. .00016 gap) ..	£9/13/6
Ultron 15H, 15HT, 15HL (Medium impedance extreme range. .00016in gap)	£9/13/6
Ultron 15S, 15ST, 15SL (High efficiency record .00025in gap)	£9/13/6
HE2, HE2T (Record-play, commercial quality .0002in gap)	£6/3/
EU,, EUT, EUL (High efficiency erase),	£5/7/
H4 (Record-play) and EH4 (Erase) Miniatures .0002in gap	£5/2/

Note: "T" denotes upper half track, "L" lower half track, all others full track (except H4 and EH4, which are half track).

SEND 4/ Postal Note with this advt. (Include name and address) for a copy of MAGNETIC TAPE HEADS, containing full details of all heads, including Stereo, High Fidelity Circuits, hints to builders, etc. A FREE COPY WITH EVERY HEAD.

Available from Homecrafts Ltd., 290 Lonsdale St., MELBOURNE.
A. G. Healing Ltd., 400 Flinders St., ADELAIDE.
A. E. Harrold Ltd., 123-125 Charlotte St., BRISBANE.

Manufactured solely by:

L. B. PRODUCTS

95 McDonald Street, MORDIALLOC, S.12, VICTORIA. XY1596.

A
Happy Christmas
AND A
Prosperous New Year
TO ALL OUR FRIENDS
THROUGHOUT AUSTRALIA

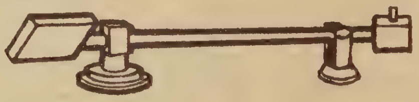
IRONCORE TRANSFORMERS
PTY. LTD.

Makers of
HIGH QUALITY TRANSFORMERS
and
"FIESTA" APPLIANCES

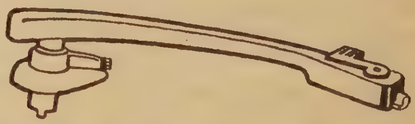
HIGSON LANE MELBOURNE C.1.
PHONE 63-4771.

U. R. D. FOR

Build up to the thrill of stereophonic, High Fidelity reproduction. If you already have High Fidelity, all you need is a stereo pick-up head, a second amplifier

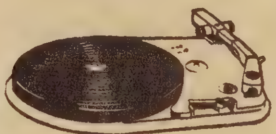


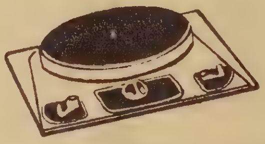
DECCA STEREOPHONIC PICK-UP
This pick-up has won incredible world wide acclaim. Fitted with a .0005 diamond stylus, it tracks perfectly at a pressure of 3 grammes. Discs played with it have shown no trace of wear after 120 playings. Produces fine stereo sound, and plays standard L.P. discs perfectly.



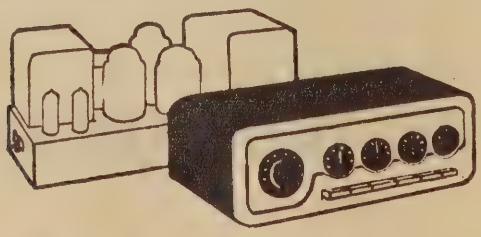
GOLDRING G.60 TRANSCRIPTION ARM
Wired with four contacts for Stereophonic and Monaural reproduction. Features four-contact plug-in shell so that any high-quality cartridge can be inserted. Special adjustment for height, weight and balance. Precision designed for high-quality equipment and all stereo applications.

GARRARD STEREO RECORD PLAYER
High quality single record player complete with GCS10 stereo pick-up at reasonable price. Four speeds, selected by sliding knob. Speed variation of plus or minus 3%. Fitted with patent automatic stop with provision for disengaging. Plays records up to 16" diameter with minimum tracking error.

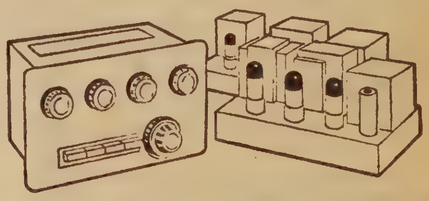




GARRARD 301 TRANSCRIPTION MOTOR
Turntable and mounting plate made in diecast aluminium. Robust induction motor floats on six tensioned springs. Turntable spindle made from high-quality steel, with bearings of cast phosphor bronze. Three speeds adjustable by plus or minus 2½%. Available from stock.



QUAD 22
A development from the world renowned Quad 11, Quad 22 incorporates refinements in design, greater flexibility of input and includes facilities for either stereo or monaural. Operates from discs, tape, radio or microphone, single channel or stereo. Power output: 15 watts throughout the range 20-20,000 c/s.



ROGERS R.D. JUNIOR AMPLIFIER AND STEREO-CONTROL UNIT.
This entirely new unit incorporates every essential for High-Fidelity reproduction from tape, records or radio. Can also be used for monaural recordings. The control unit may be used with two R.D. Junior amplifiers (20 watts output), or two R.D. Cadets (10 watts output), or one of each!

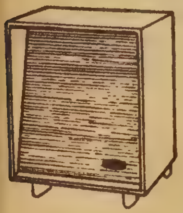
UNITED RADIO DISTRIBUTOR

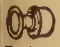
STEREO IN HI-FI

with control unit, and a second speaker system.

Write, telephone or visit, at U.R.D. you'll get all the help and advice you need.

Stereo without High Fidelity is like a picture without colour



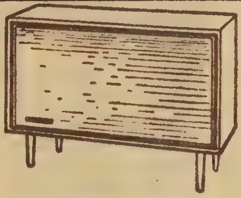


Trebax

Axiom 300

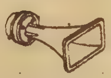
GOODMANS SHERWOOD 11

Balanced 3 — Radiator Twin-unit, Full-range, High-Fidelity Loudspeaker System. Bass and middle registers reproduced by an Axiom 300. At 5 Kc/s. signal is transferred to Trebax pressure-driven, high-frequency unit. Overall range, 30 c/s.-16,000 c/s. Capacity: 15 watts. Dimensions: 25½" x 23½" x 20½". Polished walnut or pine. Plans available.



Trebax

Trebax

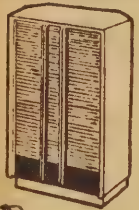


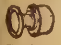
Midax 650

Audiom 60

GOODMANS AXIOM 15/4

Entirely new quadruple Radiator Full-range, High-Fidelity Loudspeaker System. Overall frequency range, 30 c/s.-16,000 c/s. Bass Unit: Audiom 60 12" single-cone unit (30-950 c/s.). Mid Range: Midax 650 pressure-driven horn unit (950 c/s.-5,000 c/s.). High Frequency: Two Trebax pressure-driven horn units (5,000 c/s.-16,000 c/s.). Capacity: 15 watts. Dimensions: 19" (plus 7" lens) x 36½" x 13¾"





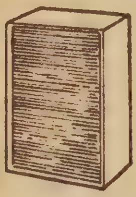
Trebax

Midax 400

Audiom 80

GOODMANS 325

Complete Three-unit High-Fidelity System. Overall frequency range: 30 c/s.-16,000 c/s. Bass Unit: Audiom 80 15" single-cone unit (30 c/s.-750 c/s.). Mid Range: Midax 400 pressure-driven horn unit (750 c/s.-5,000 c/s.). High-Frequency: Trebax pressure-driven horn unit (5,000 c/s.-16,000 c/s.). Capacity: 25 watts. Dimensions: 33" x 22" x 20½".



Axiette

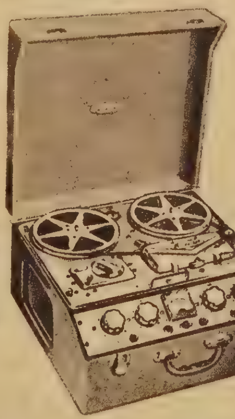
GOODMANS AXIETTE CABINET

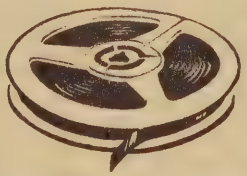
Single-unit High-Fidelity Loudspeaker System. Frequency Range: 40 c/s.-15,000 c/s. Axiette speaker gives excellent angular coverage at all frequencies. Power output—6 watts, yet only 8 inches in diameter. Operating at normal room volume, the most critical listener would be unable to distinguish between Axiette and more expensive systems. Dimensions: 24" x 17" x 9¼". Ideal for Stereo.

ROGRAPH SERIES 4

this new development of incomparable Ferrograph ies, there are eight ortant design improvets. Every Series 4 is dily adaptable for a ety of applications. For mple, the new head cover nits many head changes additions. Also Series is easily converted to a es 4S merely by plugging dditional stereo head.

ies 4A/N, 4S/H: 3¾ x 7½ i.p.s.
ies 4A/H, 4S/H: 7½ x 15 i.p.s.
re-ad unit as required.





MSS MASTERTAPE

The only tape polished on both sides to almost eliminate surface noise. As a result of the fine finish of the working surface, wear is almost negligible and intimate contact with the recording and replay heads is assured. 7-inch spools. Standard: 1,200 ft. Long Play: 1,800 ft.

UNITED RADIO DISTRIBUTORS PTY. LTD.
175 Phillip Street, Sydney.

Please send further information about the equipment illustrated in your advertisement, particularly..

To: Name..

Address..

.... /12

'TY. LTD.

PHILLIP STREET, SYDNEY. PHONE: BW 3718, BW 3926.

AMATEUR BANDS WITH BILL MOORE

NOTHING FINAL YET FROM I.T.U.

Decision on the final frequency allocations for Amateur Stations to be gazetted at the ITU Geneva Conference are being awaited with interest.

INDICATIONS to date show that the 3.5 and 7.0 mc/s bands will be cut but other HF allocations will remain unchanged.

Although final news is not available from the I.T.U. Conference at Geneva on Amateur Frequency Allocations at the time of writing, information coming from the Conference gives some indication of the possible outcome of deliberations on the subject.

Final decisions will not be promulgated until towards the end of the conference. A plenary session will either endorse or modify the recommendations of the study groups who investigated allocations in various portions of the spectrum.

A total of over 60 sub-committees worked on different subjects facing the conference including those of fitting the various services into the available frequencies.

News of the progress of the deliberations was provided by Federal President of the W.I.A., Max Hull, VK3ZS, who presented regular reports from the W.I.A. observer at Geneva, John Moyle, VK2JU.

Another source of information has been via Frank Hine, VK2QL, and provided by Prose Walker, W4CXA, who himself was at Geneva until mid October.

COMMENDABLE WORK

W4CXA's final report on his return to the U.S. was very informative. Prose spoke highly of the work of John Moyle VK2JU at the conference on behalf of amateurs and how active he was in the interests of the Amateur Service.

Main pressure on amateur bands came from H.F. Broadcasting interests especially from newly constituted countries such as Ghana and Malaya. These countries have been without specific assignments in the SW B/C bands. In the tropics Short-Wave Broadcasts are an important part of any service, providing information and entertainment.

High static levels reduce the effective cover of normal B.C. band transmissions and at distances only a few miles away from the broadcasting centre listeners resort to the short-waves for entertainment.

Most useful portion of the spectrum for these broadcasts is from 3 to 9 mc/s and this is one of the reasons why pressure was so high towards a reduction of the 7mc amateur band.

Radio amateurs in attendance at Geneva held many meetings to discuss the problems facing the Amateur Service generally.

Extreme pressure has been applied from all sides to try and ensure the adoption of their particular proposal. There was no sentiment shown in any negotiations which sometimes finished as a major political issue.

It appears at this stage that the suggested Amateur Bands in the HF portion of the spectrum that will be presented for final endorsement by the Plenary Session will run as follows (applicable to Region Three which includes Australia):

1840 to 1860 Kc/s.
3500-3700 Kc/s.
7000-7100 Kc/s.
14000-14350 Kc/s.
21000-21450 Kc/s.
28000-29700 Kc/s.

All bands to be exclusively amateur.

At this stage the arrangements for the UHF/VHF section have not been discussed.

INTERZONE WORKING

Some of the points that arose from the deliberations are listed below. The band 7000-7300 Kc/s will still be available to amateurs in zone 2 (the Americas). It is suggested, however, that all interzone working shall be carried out in the segment 7,000-7,100 Kc/s. Another point raised was that signals from shortwave B/C station should not be beamed to Region 2 in the 7,100-7,300 Kc/s sector.

The Australian delegation withdrew their proposal to curtail the 14 Mc/s band by 50 Kc/s due to lack of support from other nations.

In the 28 Mc/s band some nations propose to reserve the right to operate low-powered fixed stations in the region above 29 Mc/s. According to the arrangement they may so operate, but on a non-interference to the amateur service basis.

This is the first occasion in I.T.U. history when commercial stations are required to operate in this manner.

Greatest support for the amateur service and for retention of existing bands in Region 3 came from the New Zealand delegation, who grimly opposed any reduction in the 3.5 Mc/s allocation. They pressed, too, for a 25 Kc/s segment allocation in the 1,800-1,900 Kc/s region for their amateur radio emergency corps. Prose W4CXA spoke in admiration of the N.Z. delegation's support for amateur radio.

It was also decided that nations attending should remove existing transmitters from the proposed exclusive amateur assignment 7,000 to 7,100 Kc/s.

Nearly 70 government delegations or representatives attended plus 15 International bodies. The International Amateur Radio Union was represented by Region I nominees John Clarricoats, G6CL, and Per-Anders Kinnman, 5M5ZD, and both spoke on a number of occasions when matters affecting amateur radio were discussed.

Incidentally, the acting secretary o
the I.T.U. is an amateur, Gerald Gros
HB9IA.

More than 4,000 proposals covering a
subjects under debate were received an
these occupied more than 800 pages o
printed text. Reports on study grou
and committees' activities necessitat
that roneo machines produce abo
1 million sheets a week.

Throughout the conference a simu
taneous translation in the three offici
languages (French, English and Spanis
was presented. It was possible for del
gates to readily follow the deliberation

Only governments vote at the confe
ence. Other agencies may participate
the debate, such as the I.A.R.U., b
that is all.

TREATY, REGULATIONS

The conference will finally draft bo
a new treaty and a new set of regul
tions and together the two documen
will form a volume of some 500 pag
or so. From an amateur's viewpoi
the really important material appears
the regulations. In these, services a
defined and frequency allocations set o
The conference has the power to scr
all the Atlantic City regulations, b
this is extremely unlikely.

They are only 12 years old and mo
of them are entirely satisfactory. On
regulations outmoded are likely to
changed.

At international conferences such
Geneva, experts, seriously minded peop
hope to come up with an equitable so
tion to what is becoming an extreme
complex problem. The radio spectru
is unfortunately not stretching, but t
demands are increasing daily. New s
vices require space and gaps in the sp
trum to fit them in are not there.
is only by pruning existing allocatio
can they be accommodated.

The radio amateur was well represe
ed at the conference far more effectiv
than ever before at a meeting of t
nature. The position of amateur f
quencies as indicated at the moment
reasonable and better than some of
more pessimistic forecast.

The final allocations, of course, w
not be decided until the plenary sessi
when they could be changed.

Amateurs await with interest the fi
decisions and the completed report
the W.I.A.'s observer at Geneva.

W.I.A. NOTES

THE October meeting of the N.S.
division of the W.I.A. took the fo
of an oldtimers' night and was app
ciated as a most instructive and inter
ing evening. Oldtimers were introdu
more or less in order of seniority.

First to the rostrum was still-act
amateur, Wally Hannam, VK2AXH. W
spoke of the early days of radio b
to 1907 and of his trip to Antarctica w
Mawson as a wireless operator. He
membered, too, the inaugural meeting
the Wireless Institute, held in 1910,
a Press cutting from the "Daily Te
graph" was read covering this meeti

The second speaker also attended this meeting. He was Jack Pike, VK2JP, who produced a number of Press cuttings and booklets covering amateur working prior to World War I. Jack described his early activity and showed one of the first valves to reach this country. Basil Cooke was next to the rostrum, although not now an active amateur, he was well known pre- and post-World War I. He was operator at 2CM during the "Tahiti" Transpacific tests and described activity during that period.

Well-known amateur, Joe Reed, VK2JR, then covered the first interstate exchange of signals.

VINTAGE GEAR

The contact was between his station in Melbourne and 2CM, station of the late Charles Maclurcan, in Sydney. Joe showed and described much of the vintage equipment on display. Next speaker was Lionel Swain, VK2CS, president of the Hunter branch, who produced a grid leak made from carbon-impregnated blotting paper and spoke of the early days in amateur radio in Newcastle. Lionel is still very active and extolled the virtues of S.S.B. in an appeal for more use of this mode of transmission.

Other oldtimers that followed, covering various stages of history in amateur radio, were Lionel Todd, VK2LS, Ted Barlow, VK2GQ, Horry Lapthorne, VK2HL, and Dave Gray, VK2IJ.

Many interesting features of the early days were covered by the speakers, including the first exchange of signals between Australia and the U.S. and it was the type of discourse that could well go down on tape for the record.

Science House was filled to capacity with about one-third of the amateurs present with over 25 years of activity behind them.

It is certain the evening will be repeated and it could well cover the period 1922 to 1926, when amateurs opened up he shortwave portion of the radio specrum for world-wide working.

At the meeting at a business session approval was given to the council's scheme to proceed with the purchase of administrative offices. Aspects of the proposal were discussed by members. Intitute funds are available for the purchase, the main problem being the finding of suitable premises. The scheme covers a number of phases of divisional activity.

It would provide office space, room to house the library, a suitable small hall for meetings and A.O.C.P. class intruction. Storage is required for the nstitute's records and space for a VK2AWI transmitter as a stand-by for VK2WI Dural and for instruction purposes.

The acquisition of premises would be a forward step in the growth of the N.S.W. division and members await the ouncil's decision with interest.

FIELD DAY

DESPITE foreboding weather forecasts over 100 persons gathered at the Lawson Swimming Pool in the Blue Mountains for that section's Field Day onducted in October. They were not to be disappointed as the weather was xcellent, and all enjoyed the outing.

Main feature was the field events and after registration searchers set off on the 144 mc/s Hidden Transmitter Hunt. Bob Lear, VK2ASZ, did a good job as the fox as he had the hounds milling around his location for quite a period.

Hidden by a water tank the transmitter was finally found by Hunt expert Bob Winch, VK2OA, after 50 minutes. Bathurst team comprising Graham Nixon-Smith, VK2AGN, and Neville Wilde, VK2DR, were second.

The Blindfold 144 mc Hunt was entertaining and heats were conducted during the day. The Halo Antenna hanging between two trees provided a good signal. Winners of the finals in this event were Ladies Mrs Moore, XYL, VK2HZ, Children Miss Leslie Petrich jun. OP, VK2CZ, and Gents Graham Nixon-Smith, VK2AGN.

The other two field events the 7 and 144 mc/s scrambles run in the afternoon provided very high scores. They were of half an hour duration only. On 144 mc/s Dave Andrews, VK2AWZ, made 20 contacts in the period to win with Phil Card, VK2ZBX only one QSO away in second place.

FINE SCORE

Jim Cummings, VK2PM, turned in a remarkable score of 26 contacts on 7 mc/s, nearly one per minute to win the cup. Dave, VK2AWZ was close by with 25 contacts.

After the drawing of the lucky numbers at 4 p.m. the prizes were presented by Section Chairman Wal Cromie, VK2MZ.

Introductory remarks were made by State President, Dave Duff, VK2EO. The ladies enjoyed a scenic bus tour around the sights of the Blue Mountains during the afternoon while the kiddies made short work of drinks and ice-creams. Section members had a busy time organising the events which also included the Magic Magnet and Bran Dip, they were rewarded by the excellent attendance.

From farthest afield came Ken Laycock, VK1ZCA of Canberra, while Major Collett, VK2RU arrived from Gosford. Amongst the calls recorded were:—

VK2ZCF, 2ZAL, 2QA, 2HZ, 2NK, 2MZ, 2ART, 2ADF, 2WJ, 2AWZ, 2DR, 2EO, 2OA, 2ASZ, 2CZ, 2PM, 2ZGW, 2AGN, 2APQ, 1ZCA, 2ZMP, 2OT, 2ALJ, 2ZJC, 2DS, 2ZTM, 2RU, 2VL, 2AT, 2AVW, 2AVK, 2ACP, 2RM, 2ZBX, 2ZBU, 2ZMS, 2OZ, 2ZFC, 2ZEL and 2JX.

WICEN IN N.S.W.

THE WIA's N.S.W. WICEN system swung into operation on October 30 when landline communication was lost with Bega during serious flooding on the South Coast. VK2AYW of Bega handled traffic assisted by VK2ASF of Eden with VK2ANB of Sydney. VK2WI at Dural was manned by VK2EO and maintained watch on 7050 kc/s until the early evening. Other stations assisting included VK2MP, VK2ACP and VK2AGS. Fortunately the lines were soon re-opened but the emergency disclosed how readily the WICEN organisation could be brought into operation.

(Continued on Page 123)

To our many
MAIL ORDER CUSTOMERS
throughout the
Commonwealth!

We take this opportunity to thank you for your support during the past year and to

WISH YOU A HAPPY CHRISTMAS & A VERY PROSPEROUS NEW YEAR

NEXT YEAR WE HOPE TO GIVE YOU AN EVEN QUICKER AND BETTER SERVICE.

If you require a speedy reply to any correspondence please assist us by sending a stamped and addressed envelope.

Price's Radio

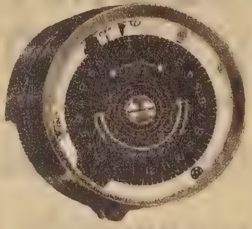
ESTABLISHED 1922

FOR ALL RADIO PARTS

5 AND 6 ANGEL PLACE,
SYDNEY.

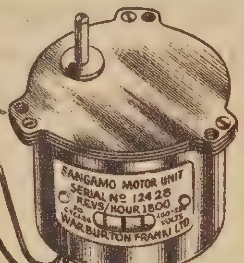
THE WARBURTON FRANKI PAGE No. 1

SANGAMO SSA/0 TIME SWITCH



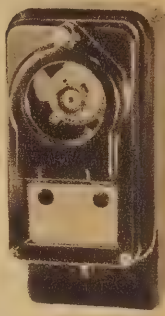
Gives complete and variable control over heating and power circuits, street lighting, Neon signs. Provides for up to three on-off operations every 24 hours. Features day omitting device, independent manual operation, 20 amp. contacts. Price £7/19/9.

SANGAMO S.7 SYNCHRONOUS MOTOR UNIT



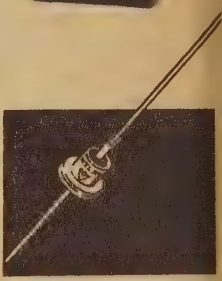
Small, totally enclosed, internally geared unit. Suitable for powering recording instruments using circular paper charts up to 12in dia. Obtainable in 18 spindle speeds ranging from 1/24 RPH to 3,600 R.P.M. and also 1 rev. per 7 days . . . either clockwise or anti-clockwise rotation. Price £4/5/9.

SANGAMO WF11 SPRING RESERVE TIME SWITCH



Suitable for the control of all lighting, heating and power circuits, where it is essential that the time switch continue to function for a limited period in the event of interruption to the power supply. Price £18.

"INTERNATIONAL" SEMICAP



High Q voltage variable capacitor Q of 1,000 plus at 1 Megacycle. Range 3-30 Pfd. Offers: Low Power requirements . . . Temperature insensitivity . . . Miniaturisation. Price 17/6 plus 12½ p.c. S.T.

WF VARIAC CONTINUOUSLY ADJUSTABLE TRANSFORMERS

For all types of Voltage, Power, Speed and Heat Control.

	100R	V5 (illustrated)
Load Rating	2,000 VA	500 VA
Input Voltage	230	230
Output Voltage	Variable 0-270	Variable 0-270
Rated Current	8 amps.	2 amps.
Maximum Current	9 amps.	2.5 amps.
(also provided with 115 Volt tap)		
Price	£29/1/9 plus 12½ p.c. ST	£19/6/6 plus 12½ p.c. ST

HEATHKIT S-3 ELECTRONIC SWITCH KIT

Allows oscilloscope observation of two signals simultaneously, such as input and output of amplifier. Simple to build. Cuts your cost in half.

Price

£24/12/6

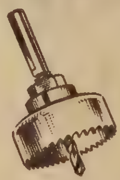
plus 12½ p.c. S.T.

BLACK AND DECKER TOOLS
POWER UNIT and ATTACHMENTS

U500 ALL PURPOSE POWER UNIT

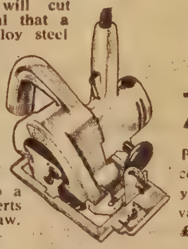
A world of power at your fingertips to Saw, Sand, Buff, Grind, Drill, Polish and Turn.

Price £19/10/-

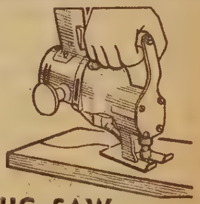


HOLE SAWS These saws will cut clean, round holes in any material that a hacksaw will cut. Coarse tooth alloy steel for wood, fibre, bakelite, cast iron. Fine tooth for sheet metal, steel and other thin materials. Sizes range from 5/8in to 4in. Prices from 19/6 to £3/17/6. Mandrels available for all sizes.

SAW ATTACHMENT



Can be fitted to your U500 Power Unit, or to a Black and Decker 3/8in Utility Drill. Converts your drill into a powerful portable power saw. Price £6/19/.



JIG SAW ATTACHMENT

Precision engineered, close coupled attachment for your Power Unit. An invaluable accessory. Price £8/10/.

WARBURTON FRANKI

VIC.—359 LONSDALE STREET, MELBOURNE — PHONE MU 8351
N.S.W.—307 KENT STREET, SYDNEY — PHONE BX 1111
Q'LD.—233 ELIZABETH STREET, BRISBANE — PHONE 31 2081

ON SHORT-WAVE BY ART CUSHEN

CHANGES IN DUTCH BROADCASTS

Radio Nederlands in Hilversum has put another transmitter on the air, and now have two programmes each on two transmitters for broadcasts directed to many parts of the world.

FOUR transmitters, two of which are coupled to each program, has nabled the Hilversum station to subantially increase its broadcasting schedle. The station has also announced that new edition of a very well written ooklet on the use of aerials designed or short-wave listening, and details on ie types and methods of erection, is gain available free to listeners.

Eddy Startz the genial announcer of ie "Happy Station" program is also nding out to those, who request it, a 960 calender, which lists details on the ansmissions as well as being of novel esign. Both of these items can be ad by writing Radio Nederlands, P.O. ox 139, Hilversum, Holland.

The extension of the broadcasting hedule of Radio Hilversum in Holland now in effect, and it covers additional mes, and new frequencies for most of e transmissions.

Sunday Broadcasts

4.00 to 4.20 p.m. in Dutch for New ealand on 11720, 15220 Kc.

5.30 to 5.50 p.m. in Dutch to Austraa, on 11730, 15220 Kc.

6.30 to 8.20 p.m. to Africa and Far ast, 21565 and 21480 Kc.

8.30 p.m. to 10.00 p.m. "The Happy ation" program on 21565 and 9745 Kc.

9.00 to 10.50 p.m. in Dutch to Ausalia and New Zealand on 25610, 21480 c.

10.30 to 11.30 p.m. to Indonesia on 565 and 17775 Kc.

11.00 p.m. to 1.50 a.m. to South East sia on 21480 and 15220 Kc.

2.00 to 3.30 a.m. "Happy Station" ogram on 25610, 21480, 15220, 6020 c.

Weekdays

4.00 to 4.20 p.m. Dutch to New Zeand, 15220, 17730 Kc.

5.30 to 5.50 p.m. Dutch to Australia 15220, 11730 Kc.

7.00 to 7.50 p.m. New Zealand, Auslia, English on 21480, 17775 Kc.

8.00 to 8.20 p.m. in Dutch, 25610, 565 Kc.

8.30 to 8.50 p.m. 21565, 15445 Kc.

9.00 p.m. to 10.50 p.m. to Australia, utch on 25610, 21480 Kc.

10.30 to 11.00 p.m. on 21565, 17775 .

11.00 p.m. to 1.15 a.m. on 21480, 220 Kc.

Midnight to 12.50 a.m. English on 040, 21565 Kc.

1.00 to 1.50 a.m. on 21565, 17810 .

Hilversum now uses the following equencies, 26040, 25610, 21565, 480, 17810, 17775, 15445, 15425, 220, 11950, 11730, 9745, 9715, 90, 6025 and 6020 Kc.

UNITED NATIONS COMMAND

Radio VUNG, "The Voice of the United Nations Command," which is still operating from both Japan and South Korea, now broadcasts on a revised schedule, reports the World Radio Handbook Bulletin. The VUNG Japan Network, on 9560 Kc, with 10 Kw, is on the air from 9.00 p.m. to 4.00 a.m.; also on 6015 Kc. 20 Kw. from 1.00 a.m. to 7.00 a.m.

The Korean Network in Seoul, South Korea, is on the air from 6.30 p.m. to 1.00 p.m., and uses 2405, 3985Kc., both with the power of 300 watts. This network tests in English from 6.30 to 7.30 p.m.

The stations of the Korean Broadcasting System also relay the programs and carry them from 11.30 p.m. to 1.00 a.m. on 6035 Kc. 1Kw, and 11.30 p.m. to midnight the additional station on 9640Kc is used for the transmission.

NEW CUBAN STATION

A high-powered installation is soon to be built near Havana, according to the Cuban Communication Minister, who rates it in the class of VOA, Moscow and BBC. Technicians are to be trained in West Germany and, from this report, which has been sent by one of our readers, Ronald Pearson, Parramatta, N.S.W., it would appear that construction has now commenced. Cuba is to ask the present conference of the International Telecommunication Union in Geneva for better frequency assignments, claiming that the larger countries now dominate short-wave broadcasting, with little left in the way of frequencies for smaller nations. The possibilities of reception of this new station here would be bright, when one considers the very good service being had from the Haitian stations with much lower power and coverage.

PADANG ON 3960KC

Broadcasts from Radio Republic Indonesia from Padang, in Sumatra, have recently undergone changes, and the former three transmitters have been now replaced by a single station, which operates on 3960 Kc. According to advice from the station, the present schedule is 9.30 to 10.45 a.m., 8.30 p.m. to 2.30 a.m. On Sundays and holidays the first transmission is from 10.30 a.m. to 5.45 p.m. The letter from the Head of the Studio, M. Tahir Harahap, verifies reports, and the address is Alamat Djalam Sukarno, 14, Padang, Indonesia.

PRAGUE USING 9665 Kc.

The broadcasts from Prague to North America, which provide fair listening in our afternoons, have been now received on a new frequency. When the change was announced the frequency was 9655 Kc, but it has now been moved to 9665 Kc, and is heard with the English broadcasts at 1.00 and 3.00 p.m. The station has also been well received on the other frequencies, which carry the program, 9550, 11720, 11740 and 11840 Kc, while, at 10.30 a.m., in the first of the transmissions to North America, 15280 Kc is used in preference to 9665 Kc. The Czechoslovakian Radio, in its transmission to Australia and New Zealand, is now received at its best when opening at 6.30 p.m. in an hour-long service, which is on 11720, 15280 and 21450 Kc, the complete program being in English, with the 11720 and 21450 Kc frequencies proving the stronger signals.

ANKARA ON 9745 KC.

The reception at good level of Radio Ankara on a new frequency can at present be had in the mornings, when this frequency carries the English broadcast from 7.00 to 7.45 a.m. For many years this service has been on 9465 Kc., but on a recent morning it was noted on this new outlet, with the same program also being broadcast on 15160 Kc. The 9745 Kc. proved much the stronger signal as the severe side interference from the Voice of America transmissions on 15155 Kc. spoilt the weaker Turkish broadcast on the 19 metre band. The program consisted of news and light music and, on Monday mornings, the station devotes most of the broadcast to answering listeners' letters.

NEWS FROM AFRICAN S.W. STATIONS

Belgian Congo station Coquilhatville, a regional relay of Radio Congo Belge, lists the call-sign as OTD2 on 5995 Kc, and the power used is 10,000 watts. The station formerly used 6070 Kc. The station operates from 1.30 a.m. to 6.00 a.m. and from 9.00 p.m. on Saturdays and 7.00 p.m. on Sundays. Next year plans are envisaged to add a transmission from 1.30 to 3.30 p.m. and 7.30 to 9.30 p.m. The station address is Regional de Coquilhatville, Box 1061.

Ivory Coast station, de la Cote d'Ivoire, Box 2261. Abadjan states normal power is now 10 Kw, but 25 Kw is used on an experimental basis. Plans include a two network broadcast with transmissions throughout the day.

Mozambique station Emisora de Areo Club, P.O. Box 3, Beira, verifies transmission on 3290 Kc though lists 3255 Kc as the outlet. Power is 300 watts with omni directional aerials, CR7IB is the call on 3290 and on 7255 Kc s CR7IC. CR7IB will soon be increased to 1000 watts, and the schedule will be 2.30 to 3.30 p.m., 7.30 to 9.30 p.m., and 4.00 to 6.30 a.m.

Somaliland station at Hargeisa, releases details from J. M. Webber, Information Officer, that the power on 4797 Kc uses 1000 W. transmitter, and that on 9667 Kc. uses a 5000 W. transmitter with dipole. The present schedule is 11.30 p.m. to 1.30 a.m. in Somali, and in English from 1.30 to 2.30 a.m. The station now issues a verification card with a photo of the studio and transmitter building.

THE WARBURTON FRANKI PAGE No. 2

RECTIFIERS

BATTERY CHARGER type. 12 volts at 6 amps. Max. Plates are 3in square and overall size over terminals and mounting screw is 3¼in x 3 3/8in. **Priec 65/-, Pack. and Post, 1/3.**

Other types made to order — assembled from American "International" Plates and Components.

IMPORTED MULTIMETERS

Suitable Radio and TV measurements.

Ranges—0-1 and 0-250 milliamps.
0-10 and 0-100K ohms.
0-10, 0-250, 0-500, 0-1,000 A.C. and D.C. volts.

Sensitivity—1,000 ohms per volt.

Price, complete with Leads and Instructions, 89/6. Pack. and Post, 3/-.

BUILD YOUR OWN V.T.V.M. with FAMOUS AMERICAN HEATHKIT V-7A

World's largest selling V.T.V.M. Kit

Specifications. D.C. Volts. 7 ranges, 0-1.5 to 0-1,500. . . Input Resistance plus minus 3 per cent full scale . . . A.C. Volts, 7 R.M.S. Ranges R11 megohms . . . Sensitivity 7,333,333 ohms per volt on 1.5V range . . . Accuracy 0-1.5 to 0-1,500 . . . Frequency Response (5V range), plus minus 1 DB 42 C.P.S. to 72 Mc. . . . Accuracy plus minus 5 per cent full scale . . . 7 peak to peak Ranges, 0-4 to 0-4,000 . . . Resistance—7 ranges—measures .1 ohms to 100 megohms with internal battery . . . Size 7.3/8in x 4.11/16in x 4.1/8in . . . Weight 7 lbs . . . **Price £27/10/ plus 12½ p.c. Sales Tax.** Post. Vic. 3/9. Int. 8/4.

EASY TERMS available in Victoria, **£6/18/9 DEP. and 45/- monthly for 12 months.**

XMAS BARGAINS

IMPORTED RIBBON TWEETERS. Famous KELLY—Shopsoiled, £19/10/. Pack. and Post. 4/6.

4-SPEED STEREO RECORD CHANGERS. Plays Std. 78, L.P. and Stereo Discs. Brand New Sealed Cartons. £16/19/6, freight forward.

AMPLIFIERS. Imported Grampion-Mullard 5-10—Amplifier, only **25gns;** Type 54 Control Unit to suit, **13gns;** Type 56 Pre-amp Control Unit to suit, **19gns.** (Freight forward.)

MICROPHONES. Imported Grampion Model D.P.1. Available either Grid Impedance or 200 ohms. First-class dynamic movement. Shopsoiled, **10gns.** Pack. and Post. 4/6.

ELECTROLYTIC CONDENSERS. 32 mfd 600 volts Peak Pigtail Connections. 8/11 ea. Pack. and Post. 4d.

GUITAR AMPLIFIER. 7 WATTS — Attractive Cabinet C/W 12in speaker. **£29/10/.** Easy terms—deposit £7/10/-, 12 monthly payments of 41/3.

RESISTORS. 2800 ohms 10 watts. **1/11 ea.** Post free.

PANEL LAMPS. 2.5 volt 5 amps. Tubular M.E.S. **6d. ea.** or Box of 10, 4/6. Post free.

POWER TRANSFORMERS. 100 m.a. 385V. 6.3, 6.3 and 5V. Brand new. **59/6.** Pack. and Post. 4/6.

CRYSTAL SETS. Jet Aircraft Germanium Diode type, complete with crystal ear plug. **35/-.** Pack. and Post. 1/6.

IMPORTED PLASTIC RECORDING TAPE.

First Quality Guaranteed.		
3in spool	200ft tape	10/6
5in spool	900ft tape	29/6
7in spool	1800ft tape	49/6

Pack and Post. 2/6 reel.

MICROPHONES. Crystal Lapel type—Boxed complete with Lead. **30/.** Pack. and Post. 2/6.

PICK-UPS. Crystal Turnover type for L.P. and Std. Recordings. Boxed complete with Rest. **59/6.** Pack. and Post. 2/6.

AMPLIFIERS

The W-F 3 a compact Hi-Fi Unit—only 8in x 5in x overall height 5 5/8in. Valve Line-up is 6AU6 Driver, 6BQ5/EL84 output and 6 x 4 Rectifier. **Controls—** Tone, combined with ON-OFF Power Switch and Volume. **Price £16/19/6.** Pack. and Post. 4/6. Two of these units make an ideal Stereo System.

SPEAKERS

Select your Speakers, for use with the above or any other system, from the W-F range—The greatest variety of Loud Speakers in Australia. Choose from **Baker, Goodman, Grampion, Jensen, Leak, Magnavox, Peerless, Rola, Stentorian, Wharfedale. Prices and details on request.**

SIGNAL GENERATORS

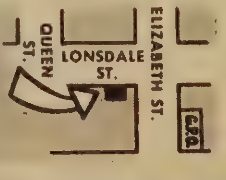
English Advance R.F. Oscillators 100 K.C. to 100 M.C. in 6 Bands, Calibration Accuracy plus or minus 1 p.c.
Internal Modulation 30 p.c. at 400 c.p.s.
A.F. Output 0-8V.
Leakage less than 3 microvolts.
Type P1 ... **£45/2/- plus 12½% Sales Tax.**
Weight 10lb. Freight forward.

EASY TERMS—Deposit £10/14/9.
12 monthly payments of 75/-.

Also type E2. Similar to above, but with External Modulation of 0-80 p.c. 10C/S to 4KC/S and 0-40 p.c. at 10KC/S. A.F. Output 0-50V at 400 C/S.

£58/3/3 plus 12½% Sales Tax
Weight 17½lb. Freight forward.
EASY TERMS—Deposit £15/8/8.
12 monthly payments of 93/9.

WARBURTON FRANKI
359 LONSDALE ST., MELBOURNE — MU 8351



Please include freight or postage with all orders

SHORT-WAVE NOTES—Continued

FLASHES FROM EVERYWHERE

UNITED NATIONS radio in Geneva as been reported from Berne as airing program in Russian at 12.45 and 1.10 .m. The broadcast is carried on HED5, sing 9545 Kc., and this transmitter is oaned for this broadcast to the United lations by the Swiss Broadcasting Cororation.

WARSAW uses several frequencies or its broadcast to Europe, which is n the air from 1.30 to 9.30 a.m. and re on 7295, 9525, 9540, 9685, 11813 nd 11905 Kc. The program is carried n these six short-wave frequencies, as ell as one of medium wave, 1205 Kc.

LONDON'S transmissions in German re well received in the mornings, and e programs are from 5.00 to 7.00 a.m. n 7320 and 9915 Kc. from 7.00 to .15 a.m. they are on 9915 and 5975 c. This latter channel is used for English by Radio," and this transmision commences at 5.00 a.m. on this elatively new frequency, which has the all sign MCP assigned to its channel.

MADRID station Radio Nacional, roadcasting from the Spanish capital, reported by Australian listeners to be iving very good reception at 7.30 a.m., hen they use the new frequency of 677 Kc.

KOREAN BROADCASTING SYS-EM at Seoul, which has been conductg test broadcasts, has been noted om 5.00 to 5.30 p.m. on HLK22 on 7835 Kc. with a broadcast in Europe. he session has French from 5.00 to .15 p.m., and the remaining 15 minutes devoted to English. The station is lso broadcasting from 2.00 to 3.00 a.m. n HLK6, using 11925 Kc., and Engsh is heard for the first 30 minutes; en follows a program in Korean. he same frequency is used from 7.00 7.30 a.m. for a further test transission.

ALASKA has been heard testing over e Army station ALH, which is located ear Anchorage, on a frequency of 4955 Kc, with test transmissions at 1.40 a.m.

RADIO TUPI, in Rio de Janiero, hich has been one of the best Brazilns in the afternoons on 19 metres, as now been heard with a session in nglish on its frequency of 15370 Kc. he session on ZYC9 is heard from 00 to 1.30 p.m., when popular dance usic, with comments in English and anish, were heard.

BRAZIL station Radio Narajuaca is ill on the air with experimental broadsts on 15240 Kc. The station has en heard in Europe in the mornings d reports are requested to Box 491 elem, Brazil. The station uses the wer of 1000 watts for daytime operans and 10,000 night-time power.

ARGENTINA station Radio Spelend, in Buenos Aires, is on the air from 40 to 2.00 p.m., and is using shortave stations, LRS 11880 Kc. 1Kw., RS2 5985 Kc., 20 Kw, and LRS2, on 42 Kc. with 20Kw. The station has ews in Spanish at 8.00 p.m., 8.30 n. and every hour on the hour after at time.

CEYLON'S Commercial Service, which broadcasts commercial programs from Colombo to Asia, now is using the schedule of 11.30 a.m. to 1.30 p.m. on 15265 Kc. and 10.30 p.m. to 2.30 a.m. on 6004 and 9520 Kc., with its English broadcasts. The Asian service in Indian languages operates from 11.30 a.m. to 2.30 p.m., and to 5.30 p.m. on Sundays on 9520 and 15120 Kc. From 9.00 p.m. to 3.30 a.m. the service is on 7190 Kc. A daily transmission to South-East Asia is on the air from 7.15 p.m. to 8.45 p.m. on 17820 Kc.

EVANGELISTIC broadcasts from Switzerland, now carried by the Tangier station with English 6.30 to 9.00 a.m. on Voice of Tangier on 11766 Kc. The agreement just signed with Radio Monte Carlo Calls for a new 100 Kw, shortwave transmitter with five directional antennas, to be used 24 hours a day from May, 1960, and the station will use the slogan "Trans World Radio." It is presumed this is to replace Tangier stations forced to close by the Government at the end of this month, when a decree prohibits the use of the Tangier International Zone, now part of Morocco, by foreign broadcasting stations.

Notes from readers on the stations they are hearing should be sent to Arthur Cushen, 212 Earn Street, Invercargill, N.Z. All times are Eastern Australian.

STOCKHOLM has inaugurated some new frequencies in its new summer schedule, and its transmission to North America is now on 9620; to South America, 9.00 to 10.30 a.m., it is on 9620 and 11705 Kc. The broadcast to South Asia and the Far East is on the air 12.45 to 2.00 a.m. and 9620 and 15240 Kc. is used.

ARMED FORCES RADIO SERVICE in New York has its new schedule reading as 12.30 to 8.45 a.m. on 21650 Kc., 12.30 to 1.30 a.m. on 17785 Kc., 1.30 to 7.45 a.m. on 17780, while from 3.00 a.m. to 7.45 a.m. the signal can be tuned on 15270 Kc.

OMDURMAN, in the Sudan, has moved to 12,000 Kc., and has been heard by listeners in the United States with programs in Arabic. The station opens its transmission at 2.15 p.m., and at times the frequency varies, but signals are normally good.

LOURENCO MARQUES radio CR7BF has moved to a new 25 metre band frequency, reports Radio Australia, and the channel is now 11740 Kc, in place of 11770 Kc. This station carries the English service and is on the air from 1.30 p.m. to 5.00 a.m. daily, but on Sunday the sign-on is at 2.30 p.m.

IMPORTANT NOTICE TO RECORD COLLECTORS.
I can take orders for overseas INDENT RECORDINGS. Also HARD-TO-GET "STEREOPHONIC RECORDINGS." And all local Aust. Releases. COLLECTORS' RECORD IRELAND. Deposit of half on all orders.
Place your orders with
M. T. BOVINGTON,
BOX 2175, G.P.O., SYDNEY.
PHONE EVENING: LM2041.

Still in the forefront!
NOVA "STUDIO" PROFESSIONAL STANDARD OR WITH
4 TRACKS
MONAURAL
OR STEREOPHONIC
2 TRACKS
Another "First" in Australia from
"NOVATAPE"
BARGAINS !
2-speed Decks: Fast forward and rewind. Excellent differential brakes. Guaranteed Frequency Response. Out they go for **£29/5/**
Collaro Deck (one left), new, but slightly scratched panel . . **£36/15/**
Ferrographs, Grundigs, Vortexions, Ericorde, New and Second-hand.
"NOVA"—
COLLARO
All Collaro and "Nova" features combined!
The Lowest Priced 3-Speed Hi-Fi Recorders in Australia

STOP PRESS—
HURRY!
PRE-AMPLIFIERS for Truvox or Collaro (new) . . . **£23/10/**
COMPLETE AMPLIFIERS **£33/15/**
DAIWA 2-speed recorder (one only) **£64**

REWINDS
and any type transformers or coil to customer's specifications. Call, ring or write for quote on your needs.
TERMS ON LOW INTEREST
For further details contact your dealer or
"NOVA"
311 SUSSEX ST., SYDNEY
BM6138-BM2350
Also 122 William Street, Sydney
Open Saturday Morning and Week Nights.
CANBERRA: CANBERRA ELECTRONICS, 4 Lansborough St., Griffith, A.C.T. X1324.
BRISBANE: STARLIGHT RECORDING CO., Penney's Building, B7336.

CUT OUT HERE
Please send without further obligation details **12/59**
of
. . . .
. . . .
ADDRESS . . . .
I enclose LARGE self-addressed envelope and 9d in stamps.

A C E Amplification Communication Electronics

RADIO

PHONE
LA 3845

136 VICTORIA R'D. MARRICKVILLE, SYDNEY, N·S·W

636 KING STREET NEWTOWN-LA7008

R. TV & H. '59 TV

21 inch 110 DEGREE

The complete kit of parts to R.TV & H. specifications and layout including: VALVES, TESTED STEANES TURRET TUNER & I.F. STRIP, TUBE MOUNTS AND MASK.

£105/0/0

WIRED AND TESTED £12/-/- Extra

FOR FRINGE AREAS

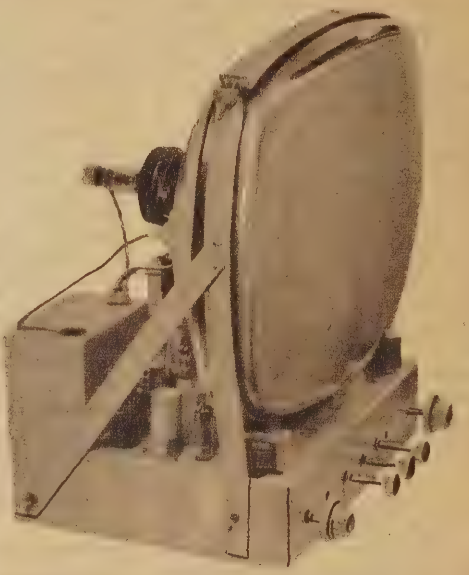
17 Valves, 4 stage Strip, Prealigned and tested.

PHILIPS NEW HIGH GAIN TUNER £107

Any individual parts, I.F. Strip, etc., can be supplied to order. Prices on application.

Chassis and E.H.T. Cage for R.TV & H. '59 TV Set £2/7/6.

Wired and tested Video Strip with valves—£11/15/



RECORDING TAPE

Hi-coercivity tape, ex A.B.C. Stations

1200ft spools	£1/12/6
500ft spools	19/6

TRANSISTORISED CAR RADIO

No power supply. No noise.
Greater sensitivity.
12 volt operation.
Complete with aerial, speaker.
Simple installation.

£34/15/-

6 volt operation, £35/15/-

State aerial and speaker required.

TV ANTENNAES

A Complete Range from

£4/15/-

AMPLIFIERS

Public Address Range
240v-AC

6 Valve, 10 watt, £14/17/6
6 Valve, 25 watt, £25/7/6
6 Valve, 40 watt, £32/7/6

Battery Operation

6 valve, 6v, 10 w. £18/15/
7 valve, 12v, 12 watt, £19/15/
7 valve, 12v, 25 watt, £24/17/6

BATTERY—AC OPERATION

6 Valve 6 x 240 10 watt, £20/15/
7 valve 12 x 240 12 watt, £21/15/
7 valve 12 x 240 25 watt, £29/7/6

STEREO RADIOGRAM KITSET

8 VALVE.

Dual Wave Stereogram, Octal Series Valves.

10 Watts Output.
2 Jensen 12in Speakers.
Bass and Treble Control.
Complete Kitset, including Valves, Speakers, Circuits.

£29/17/6

Wired and Tested.

£33/17/6

TRANSISTOR PORTABLE

Complete Kitset including Plastic Covered Cabinet and Circuit.

KITSET

6	7
£26/10/-	£29/-/-

Wired and Tested

£28/10/-	£32/-/-

D.C. TO 240 V A.C. INVERTERS

6V Input 40 watts.
12V Input 60 watts.
32V Input 60 watts.

£9/17/6

6V Input, 60 watts, 50 cycles.
12V Input, 100 watts, 50 cycles.
Suitable for Radiograms, Tape Recorders.

£16/17/6

TV I.F. STRIPS

Complete with valves aligned and tested. Your pick from Steanes R.C.S. Mahood Coils.

from £11/15/-

TV 21in or 17in

Wired and Tested 24-Valve Southern Cross Chassis less Valves and Picture Tube.

Circuit is Included

£29/17/6

STRAUSS 21in T.V. LOWBOY

16 valves and Diodes. 110 deg Picture in latest narrow-line lowboy consolette cabinet. Direct from manufacturer. Maple, walnut or rosewood cabinet.

Fully Guaranteed.

£108/-/-

Send for full details on Radiogram Chassis, TV and Amplifiers.

21in PICTURE TUBES

90 or 110 degree. Fully guaranteed.

£23/15/-

TV TURRET TUNERS

Steanes, Philips, Mullard, Astor

From **£12/10/-**

NEW BASIC KIT FOR 21-inch TV SET

Southern Cross. Suitable to adapt for R.T.H. circuit. Includes Power, TX, Sockets, I.F. Video and Sound Coils. Part wired. Strip circuit supplied.

£9/17/6

STEREOGRAM CHASSIS

Dual Wave with R.F. Stage. 8 VALVE, 6BA6, 6AN7, 6N8, EM80, 12AT7, 6BM8, 6BM8, 5Y3.
2 Rola 8MX Speakers.

£36/15/-

10 VALVE. 6BA6, 6AN7, 6N8, 12AT7, EM80, 2 x EF86, 2 x EL84, 5V4.
2 Rola 8MX Speakers.

£46/15/-

12 VALVE. Dual P.P. 14 watts output. 6BA6, 6AN7, 6N8, EM80, 2 x EF86, 4 x 6BM8, 12AT7, 5V4.
2 Jensen 12in Woofers,
2 Jensen 6in Tweeters.

£55/-/-

15 VALVE. 2 x 6BA6, 6AN7, 6AV6, 6BR5, 2 x EF86, 12AT7, 2 x 12AX7, 4 x EL84, 5AS4.
4 Jensen Speakers.

£63/15/-

Amplification
Communication
Electronics

ACE RADIO

PHONE LA 3845

136 VICTORIA R'D. MARRICKVILLE, SYDNEY, N·S·W
AND 636 KING STREET, NEWTOWN — LA7008
EVENINGS and WEEKENDS: "KALUA," Hilma Street, Collaroy Plateau, XW5956
DULWICH HILL, UNDERCLIFFE, EARLWOOD BUS AT DOOR, STOP No. 42

AR8 Communications Receivers

12 valve. Converted to 240v A.C. Thoroughly Tested. Re-aligned. Latest Ovaltone Permag Speaker

£34/17/6

NEW VALVES

12C8	12/6	AV11	3/9
6J8	17/6	6K7	5/
VT501	12/6	12SJ7	12/6
2D21	15/	12SL7	12/6
1C6	12/6	39/44	10/
1J6	12/6	47	12/6
6A6	12/6	843	£1/10/
3A4	15/	957	10/6
3B7	10/	1625	£1
3D6	10/	1629	10/
6AG5	7/6	1619	£1
6AM5	15/6	9001	8/6
6AM6	17/6	RK75	10/
1K7	5/-	VR75/30	15/
1M5	5/	RK48A	£3
6X4	12/6	954	7/6
12AT7	17/6	VR105/30	15/
832	£2/10/	7193	3/6
6J5	9/6	EL3NG	12/6
834	5/6	EMI	12/6
9003	12/6	866A	15/
6J6	15/	6AJ5	9/6
6J7G	7/6	6SN7	12/6
6N7	10/	VR150/30	15/
KTW62/6U7	7/6	6AK5	17/6
1D5	7/6	3B24	12/6
CV6	3/6	6AS7	12/6
6F6	12/6	6A8	17/6
VR65A/SP41	2/6	CK1013	15/
6X5	10/	6SA7	15/
6V6	12/6	6SL7	15/
6E5	12/6	6R7	7/6
12K8	12/6	6AB7	12/6
1T4	10/	EF39	12/6
3S4	10/	EK32	15/
803	£1/5/	EBC33	12/6
VT502	12/6	809	9/6
1L4	5/	100TH	12/6
6K6	7/6	7F7	12/6
833A	£15		

SENSITIVE RELAYS

Miniature 500 OHM operate on ½ Mil.

£2/10/-

NEW C.R.O. TUBES

Suitable for TV Pic. Tubes.

VCR 138A. 3in		17	6
VCR 97. 6in	£2	17	6
5FP7 Flying Spot, 5in		17	6
CV112		10	0
CV1957		9	6
906	£1	7	6

NEW VACUUM PUMPS

An excellent Low Pressure Air Compressor. 7 c.f. per min., 25lb pressure.

£2/17/6

NEW POWER TRANSFORMERS

285 x 285V 60mA	£1	17	6
285 x 285V 80mA	2	7	6
285 x 285V 125mA	3	7	6
325 x 325 150mA	3	15	0
250 x 250 175mA	3	15	0

C.R.O. Transformers

350 x 350v extended to 1000V 6.3, 6.3-2-5 4V filaments.
£4/5/.

Vibrator Power Transformers

6V 300V 125mA	£3	12	6
12V 325V 125mA	£3	12	6

TV Power Transformers

295V 300mA	£6	15	0
295V 400mA	£8	5	0
115V 700mA	£6	0	0

Inverter Transformers

6V 240V 40 Watt	£3	7	6
12V 240 60 Watt	£3	7	6
32V 240 60 Watt	£3	7	6

750 x 750V 750mA	£7	10	0
240V to 110V 2KVA	£10	10	0

RELAYS

6V, 3-pole Miniature	15/
1700 SPDT	7/6
1300 SPDT	7/6
500 x 500 SPDT	7/6
12 volts DPDT, 5 amp	£1
12 volts DPDT	12/6
11 volts A.C.	£1
Hi-speed Polarised relay	£2/10/
400 ohm	12/6

Hi-lo Phono Transformers	4/6
Canadian Signal Lamps	7/6
Hi-voltage, Lead-thru Insulators	1/6
each; 15/ doz.	
Hydrometers, Battery Testers	5/9
Multi-strand 4-core Cable, yard	1/
100 yards	£2/17/6
Tx Var. Condensers, 300 pf	£1/5/
60pf with Vernier	£1/1/
30 pf	10/
Throat mikes, new	3/6

OIL FILLED CONDENSERS

.5mfd 600V	3/6
2mfd 600V	6/6
.2mfd 2500V	15/
1mfd 600V	6/6
.4mfd 600V	6/6
4mfd 4000V	35/

A.W.A. STANDARD 3-GANG CONDENSERS

10/9

Postage 2/6.

GENEMOTORS

Input	Output					
24v.	250v. 100mA		£1	0	0
24v.	550v. 375mA		£2	0	0
24v.	250v. 60mA		£1	5	0
12v.	500v. 350mA		£8	10	0
12v.	1200v. 200mA		£6	10	0
24v.	250v. 100mA.	New	£2	0	0
12v.	235v. 50mA		£2	15	0
12v.	350v. 50mA		£2	15	0
24v.	540v. 200mA.	New	£2	15	0
24v.	300v. 205mA.	New	£2	15	0

NEW 24V MOTORS

Series wound Hi-speed miniature. 12,000 R.P.M. £2/10/
Shunt wound with gearbox. 2 speed and 5 and 25 R.P.M. £2/10/

AMERICAN WALKIE TALKIE 536

Complete with valves, 1 crystal, coils. Good condition **£6/17/6**

Postage 7/6.

Matched crystals and coils for 536 and 611 Units £2/10/ Per Set. Postage 1/.

NEW 24 to 32V DC.

Vibrator Power Supplies

Regulated. Filtered. 125 V DC.

£1/17/6

VALVE & CIRCUIT TESTERS

Transmission Products Units. 240 A.C. 6v D.C. Includes Socket Modification Panel, Valve Charts. Tested. Perfect order.

£22/10/-

MINIATURE HI-POWER MOTORS

With Gearbox. 100 to 1 reduction, 24v. Reversing. Ideal beam swinging unit.

£2/17/6

AT5 TRANSMITTERS

Good order, 2 to 20 meg. Complete with valves.

£5/17/6

New Coils and Intermediates

Standard or minature to suit all valves

Coils B/C, 455 KC	9/6
Coils S/W, 455 KC	9/6
Inters	11/6
Loop aerial coils	9/6
Slug tuned H.F. coils to suit 44 meg.	4/6

£6/10/-

TELEPHONES

Standard P.M.G. Type. Pedestal Magneto Phones. Tested. In perfect order.

£6/10/-

NEW R.F. METERS

0 to 1 amp. 0 to 350mA.

10/6

Used meters as above, 7/6.
Postage 1/.

WANTED

Communications Receivers. Test equipment, P.A. Gear. Large or Small surplus stock. Best prices. Call, write or phone any time.

DYNAMIC HEADPHONES

Low impedance **17/6**

Postage 2/6.
Dynamic microphones, type 7, 12/6
Postage 2/.

NEW 3BZ TRANSMITTERS

12v. operation, 2 to 10 Mgs. Air tested. Perfect order. Complies with P.M.G. requirements. For small ships, bushfires and all other services.

COMPLETE WITH 1 CRYSTAL.

£32/10/-

H.M.V. CRO. POWER SUPPLIES

350 v. 100 MA. plus 2000 V. Fully filtered.

£9/17/6

F.M. AMERICAN Pack Set Walkie Talkie

17 miniature valves, 40 channels, 27 to 38 megs. Batt. operation. Complete with valves

£12/17/6

N.B.: This is the unit used by commercial B.C. stations for outside sports broadcasts.

12V GENEMOTORS

English. 12V in. 250V out 50mA.

£1/7/6

522 TRANSCEIVERS

Complete with Valves. Excellent Condition.

£12/10/-

522 Receivers, Complete with Valves **£5/17/6**
522 Transmitters, Complete with Valves **£7/15/-**

10 Line Telephone SWITCHBOARDS

£3/17/6

25 WATT POWER RHEOSTATS

5000 ohm. 600 ohm.

10/- EACH

24V 1500 WATT GENERATORS

£12/10/-

522 TRANSMITTER OR RECEIVER CHASSIS

Less Valves.

£1/9/6

No. 19 TRANCEIVERS

Complete with 15 valves and power supply.

£12/17/6

NEW 6V RELAYS

P.M.G. type 3000. 3 makes. 3 breaks.

7/6

POST 1/-

Seasons Greetings

At this time, we of the Amalgamated Wireless Valve Co. extend to our many friends, old and new, a very merry Christmas and an enjoyable and prosperous New Year.

AWV

AMALGAMATED WIRELESS VALVE COMPANY PTY. LTD.

ANSWERS TO CORRESPONDENTS

P.P. (Brisbane, Qld.) wants to know hether we can give him the design for transistorised DC/DC converter to perate from 6 volts.

A.: It is a much more difficult pro-osition at 6 volts than at 12, and we e not in a position to assist you im-ediately. A little later, perhaps.

J.C. (Lidsdale) writes to express his ppreciation of the magazine, being one f our "first issue" readers. He tells of me of his early experiences in radio, cluding the construction of a "port-ble" set in a butter box. His present orry concerns TV aerials for fringe eas, some of the impedance matching roblems involved in multiple arrays. e suggests we run an article on this bject.

A.: Many thanks for the comments, C., and we found your comments about e portable particularly interesting. We ave in mind an article along the lines ou suggest, but it may take some time prepare. In the meantime we would efer you to the November, 1956, issue, nd the relevant chapter in Basic Tele-ision by Grob. If you do not wish to urchase this it may be possible to bor-ow it from your nearest technical lib-ary.

E.J.E. (Manilla, N.S.W.) has written vo letters concerning a recent statement y the Serviceman. His first queries e accuracy of the statement, but his econd is to explain that he has sorted e problem out and can follow and gree with the article.

A.: Many thanks for your comments, J.E., and we are glad you have been ble to straighten out this problem. We gree that it is not an easy one to ollow at first glance, but we can assure ou that the original statement was quite orrect.

R.H.W.C. (Tarragindi, Q.) wishes to se two Playmaster No. 10 (U-L) as a tereo system, in conjunction with the laymaster control Unit No. 9 of July, 959. However, he is worried about the xtra gain provided by the 12AU7 and hether this would prove excessive hen the original control section of the ain amplifier was eliminated.

A.: As you suggest, the gain of the riginal amplifier was designed to take are of the loss in the control section, nd any further gain could lead to ouble. Your suggestion to retain the riginal networks on each amplifier ould seem to be the best approach ather than attempt wholesale re-design. owever, provision will have to be made r balance as well as volume control nd may take a little working out. evertheless, it would seem to be a ound basis for experiment.

B.L.M. (West Croydon, S.A.) writes to ll us of his experiences with the 1958 V receiver, both happy and otherwise. he "otherwise" is mainly the unfortu-ate loss of a picture tube due to an ccident while handling. Fortunately, e fracture was in the base, and did ot result in an implosion.

A.: Many thanks for your report, B.L.M., and we are glad to learn that the project was finally brought to a successful conclusion. In regard to the weave on the left of the screen, there are several possible causes. We would refer you to the September, 1958, issue, page 71, for discussion of one of these. Use of the CHW1 width coil in place of the CHW2 will help, assuming that the lesser control of the former can be tolerated. Also pay attention to the dress of the yoke deflection leads to reduce capacitive coupling between them to a minimum. The frame buzz and the low sound output would seem to be related, and suggests that there is a fault in the sound IF system or alignment. The method of taking the 5.5 Mc from the plate connected 5.5 Mc trap, as used in the current receiver, is very good and gives a high output. Alternatively, the two-stage sound IF system (August, 1957) may be tried, and is very successful. We are glad to learn that you find the DC compensation circuit so effective.

J.E.O'C. (Cairns, Q.) is interested in the "Reader Built It" article in the September, 1959, issue, and wants to know the AWV and Philips equivalent of the transistors used and whether the set could be used to drive a 3in speaker.

A.: There seems to be some confusion here, as the type numbers quoted are Philips. The approximate equivalent AWV types are 2N406 (OC71) and 2N410, (OC45). The set may operate a loudspeaker, but a 3in type is about the worse possible choice due to the poor efficiency. One of the sensitive 5in types would be a far better proposition. However, it must be realised that the amount of power available from such a stage will be very small and we seriously doubt whether the idea is worth considering.

A.W. (Blacksmiths, N.S.W.) makes a number of suggestions and requests.

A.: Some of the things you suggest could be done—but at a price! The length of a technical article, for example, does not normally fill even space in the main body of the text. To make it fit, with no provision for turnover, would seriously hinder our production and also make it necessary at times to cut out sections which may be quite important, just so the article will end in the right place. We have offered progressive constructional articles in the past with a lot of discussion about individual components. We shall probably do the same again at some future date. There is a severe limit to the usefulness of simple test equipment. That one may build a particular item simply or cheaply may be less important than the fact that it is of not much use, when completed. We are always on the look out for simpler designs but we do balance them against the utility or futility of the finished item!

RADIO, TELEVISION AND HOBBIES QUERY SERVICE

ALTHOUGH still faced with production problems, we have resumed our technical query service. Readers' attention is drawn, however, to the conditions governing this service, which are set out in detail below: —

(1) Requests for copies of circuits or technical queries requiring an answer through the post must be accompanied by postal note or stamps to the value of TWO SHILLINGS. Queries not accompanied by a fee will be answered in rotation on these pages.

(2) For the 2/ fee, we will supply circuit data, as available, for up to three projects. The amount of data available varies but in no case can it include information additional to that already published in the magazine. As a rule, requests for circuits will be answered more speedily, if they are clearly identified and not complicated by questions requiring the attention of technical personnel.

(3) The technical query service is aimed primarily at assisting readers in matters relating directly to articles published in the magazine. Answers will be given in note form and only so far as can be drawn from general knowledge of the relevant subject. We cannot provide lengthy answers, undertake special research, discuss commercial designs or draw special circuits.

(4) The Editor reserves the right to return query fees or to limit the scope of an individual reply, where it is felt that a partial answer will be better than none at all. Please note that the inclusion of an extra fee does NOT entitle correspondents to special consideration.

(5) In addition to the normal query service, chassis blueprints are available for most of our projects, showing the position of all holes and cutouts for metal-working but containing no details of wiring, etc. Apart from complicated projects like TV sets and oscilloscopes, most blueprints cost 5/ each. Original photographs of most projects are also available, from 5/ for a 6in x 8in glossy print; postage 9d extra.

(6) Letters should be addressed to the Technical Editor, "Radio, Television and Hobbies," Box 2728, G.P.O., Sydney.

(7) "Radio, Television and Hobbies" does not deal in radio components nor will we, as a matter of policy, debate the relative merits of competitive products. Prices, details and specifications of merchandise must be obtained direct from our advertisers.

AV
Ω
dB
0 dB = 1 mW 600 Ω
TYPE P 817 00
40000 Ω/V =
1666 Ω/V ~

PHILIPS

new

Multimeter

40,000 Ohms per Volt DC sensitivity has been made possible by a new method of meter movement supension enabling sturdy construction of the 25µA meter.

The instrument features:—

1. **40,000Ω/V DC voltage sensitivity**
2. **Protection against overload.**
3. **Current transformer for AC measurements.**
4. **Low to high ohms ranges.**
5. **Light construction for portability.**

28 Ranges

DC

Volts 0-60 mV to 0-1200V (with EH
Probe 0-30 KV) Current 0-30µA t
0-3A.

AC

Volts 0-3V to 0-1200 } 30 c/s -
Current 0-600µA to 0-3A } 10kC/s

OHMS

0-1000Ω 0-100 KΩ 0-10 MΩ

Carrying case with shoulder strap is availab

PHILIPS

PHILIPS ELECTRICAL INDUSTRIES PTY. LIMIT

SYDNEY • MELBOURNE • BRISBANE • ADELAIDE • PERTH • HOBA

P2080/

ANSWER TO ORRESPONDENTS

(Continued from page 121)

. A. D. (Ballarat, Vic.) is interested field strength meters and has noted reply to L. O. S. in the October issue. suggests that some typical circuits ht assist readers to design their own.

. As we stated before, D. A. D., st simple designs fall very short of ctical requirements and we have yet see a really good simple design we uld like to recommend. Your state- nt about the rectifiers is correct as as it goes, but merely emphasises t the designs concerned have no am- ication ahead of the detector and thus er from poor sensitivity and select- y. Something approaching the tuner IF sections of a TV set probably uld be necessary to give a really rthwhile result.

M. P. (Ballarat, Vic.) sends us a news- er cutting concerning an accident in- ving a temporary TV aerial and a power line. He suggests it may pro- e some useful copy.

. Many thanks for the cutting M. P. we will pass this on to the Service- n for his possible use in a future icle. Our only comment for the mom- is that this seems to be one of se freak accidents where a number circumstances combined to produce tragic result.

J.C. (Newtown, N.Z.) submits several estions, including problems about tone ntrols, extension speakers, and volume ntrol problems.

A.: Unfortunately, it is very difficult answer several of your questions since ey relate to specific pieces of equip- ent regarding which we have no in- rmation whatsoever. In the matter of tone control it would be necessary know the type of control circuit used, circuit of the set, and whether the has always behaved in this way or ether it is a recent development. Even en, it might be necessary to examine set before the exact cause of the fault uld be determined. Similarly, in the atter of the faulty volume control, it virtually impossible to help without a od deal more knowledge of the circuit. e trouble could be due to a faulty ntrol, and unsuitable value (in certain cuits), or even to the control being red back to front and needing to be rned anti-clockwise to increase volume. e extension speaker problem is rather npler, and the permag speaker can be ed by connecting the voice coil in rallel with the existing voice coil. Some ismatch will result, but this is not ely to be serious in a domestic in- llation. Many thanks for the com- ents about the magazine and we hope continues to prove interesting.

B.T. (Hamilton, Vic.) writes in to say at in the course of listening he has scovered a number of stations which would like to identify. Also he would e a complete list of all the commer- l and national stations throughout ustralia.

A.: We can do no better, B.T., than refer you to the World Radio Hand- ok for Listeners. Although an over- as publication, it should be available m the major technical booksellers in stralia. We have no lists available rselves.

THE AMATEUR BANDS

(Continued from page 113)

VHF ACTIVITIES

VK6BE is reported as working with GM20Q on 50 mc/s with S9 signals. ZLIGN, a N.Z. scientific station, is conducting moon bounce experiments on 146 mc/s. Pulses are of five seconds' duration at five-second intervals. Transmissions are made at 0730 GMT on the weekends.

The J.A.s are again on the improve on 50 mc/s into VK4. VK4ZAX in Brisbane states that conditions there are not as good as in northern Queensland, but from August 10 to mid-October contacted 113 Japanese stations. VK4ZBJ's record for one month's operation is 400 J.A. contacts.

Max Hilliard, who received a tape of ZE2JV's reception of European signals on 50 mc/s, offers a dubbing of the tape to anyone sending a tape to his address at 57 Gardenia Street, Blackburn, Victoria. He is at present working on the possibility of preparing a tape of the various 50 mc/s openings that occurred throughout the world during the I.G.Y.

RADIO CLUB

THE Gosford Radio Club Central Coast Section of the WIA featured two special events in October. The first was a visit to TV Channel 2 in Sydney and the second a demonstration of Amateur Radio at the Gosford High school. The latter was given on Science Night and arranged by Rex Black, VK2YA, and was popular amongst the visitors and pupils present.

LECTURE

BOB WINCH, VK20A, lectured at the N.S.W. VHF and TV group meeting on VHF antennas and matching systems. Bob shattered a few of the ideas in use on current arrays. Earlier in the month the section conducted a long distance 144 mc/s Hunt over a 60 mile range. Bob Winch VK20A was incidentally the winner; perhaps some of his ideas are really correct. Second was Dave Andrew, VK2AWZ and in third place Jim Cummings, VK2PM and Phil James, VK2ER.

NOBEL PRIZE

TO commemorate the fiftieth anniversary of Marconi winning the Nobel Prize a group of northern island amateurs operated an amateur station from Rathlin Island.

Located off the northern tip of Ireland, it was from there that Marconi carried out many of his early experiments. Using the special call GB3RI, the station was operated 160 through 10 metres and also on the 144 Mc/s band.

CONTEST

THE C.W. gang really enjoyed their VK/ZL DX contest section. Propagation conditions were excellent and the 14 and 21 M.C. bands at their best. 21 Mc/s was open to somewhere for the whole of the 24 hours and at times signals from all continents were arriving simultaneously. Africans during the afternoon were particularly consistent.

Undoubtedly some good scores will be claimed with large country multipliers. Conditions play a large part in the success of such events and many VK and ZLs were active on this occasion.

VK2GW and ZLIAH are two who, judging from serial numbers passed, should be well to the fore in the final analysis.

INTERFERENCE

A NEW approach to TV, BC and audio interference by amateurs has been reached in the U.K., due essentially to the setting up of a special committee by the R.S.G.B. in 1958. It was called the TVI/BCI committee.

It became abundantly clear early in the committee's life that it was essential that the post-office be approached to obtain a statement of current practices of that body.

The committee required an up-to-date assessment of the practices relating to the rights of amateurs in that country.

Some interesting points arose from the statement provided by the post-office and it showed a reasonably liberal approach to the problems of interference caused by radio amateurs. The radio amateur will not be held responsible for interference when the complainant's equipment is faulty.

As a result of the negotiations established statements of fact were recorded while previously much of the administrative aspects of the post-office were a matter of conjecture.

It is the earnest wish of the committee that effective liaison with the post-office will remove the stigma of TVI and BCI as affecting amateur radio.

RADIO IS
A REWARDING
HOBBY

STOTT'S has an inexpensive Course especially prepared for Amateurs, Dealers, Salesmen, Experimenters, Servicemen, etc.

This Popular Course is especially designed for YOU.

This Student wrote:—

"Your Course has created for me a profitable business in servicing in my surrounding suburbs."

Write today for full details.

Stott's Correspondence College

159 Flinders Lane, Melbourne: 149 Castlereagh St., Sydney: 290 Adelaide St., Brisbane: 21 Grenfell St., Adelaide: 254 Murray St., Perth.

CUT HERE AND POST

TO STOTT'S: Please send me, free and without obligation, full particulars of your Course in Radio.

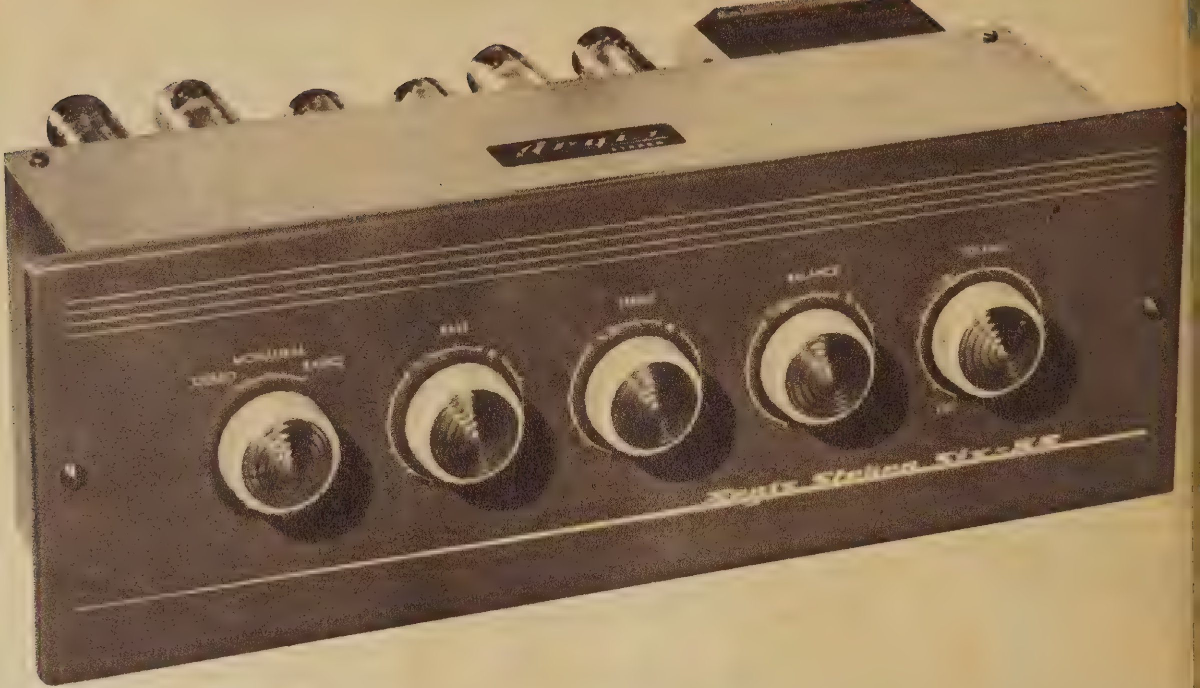
My Name ....

Address ....

....

.... Age ...... (R.H.1259)

(ADVERTISEMENT)



New Aegis Stereo Six-88 Amplifier

Note the clean, clear-cut lines of the Aegis Ultra-Linear Integrated Stereo Amplifier, Model "Six-88" in the above photograph. The attractive light Beige front panel features fine white calibrations and white knobs with lacquered, turned brass inserts.

Here is a step in the right direction from an Australian manufacturer. A stereo amplifier that embodies complete simplicity of design with spectacular performance ratings, and at a budget price that competes more than favourably with imported units.

TECHNICAL SPECIFICATIONS FOR EACH CHANNEL

POWER OUTPUT RATING: 8 watts r.m.s maximum.

DISTORTION: Total harmonic at 1000 c/s and 7 watts measures 1.34 per cent; Total harmonic at 1000 c/s and 5 watts measures 0.97 per cent. Intermodulation 40 c/s and 5 kc/s (4:1) at 7 watts measures 1.81 per cent; Intermodulation 40 c/s and 5 kc/s (4:1) at 5 watts measures 1.65 per cent.

HUM AND NOISE LEVEL: 53 db average below 8 watts with no input loading.

INPUTS: Choice of three — (1) Stereo, (2) Monaural, (3) Radio Tuner. For crystal pick-ups only. Built-in compensation for flat playback requires no external RC networks.

SENSITIVITY: Pick-up —100 mV for 7 watts output; Radio —50 mV for 7 watts output.

FREQUENCY RESPONSE: At 1 watt output within 2 db of 1 kc/s level measures 30 c/s to 60 kc/s; at 7 watts output within 2 db of 1 kc/s level measures 30 c/s to 10 kc/s.

OUTPUT RESISTANCE: Approximately 0.5 ohm on 15 ohms termination.

LOUDSPEAKER IMPEDANCES: Choice of three, accommodating (1) 3½ to 4 ohms speakers; (2) 7½ to 8 ohms speakers; and (3) 15 to 16 ohms speakers. Instant selection; no links to arrange.

POWER SUPPLY: Full wave voltage-doubler using silicon diode rectifiers delivers 260 VDC at 130 mA and 6.3 VAC at 4.1 A. No reserve for external devices. The primary circuit incorporates a safety fuse. Designed for 240 volts, 50 c/s Mains.

VALVES USED: Two type 12AX7 and four type 6BM8 plus two Silicon Diodes type OA210. Each of the six are double valves.

by Aegis Manufacturing

FRONT CONTROLS: From left to right — Selector Switch, Bass Control, Treble Control, Balance and Volume with Mains ON OFF Switch. BAS control: at 100 c/s, 11 db lift and 9 db cut

TREBLE control: at 10 kc s, 11 db lift and 1 db cut. **BALANCE** control: equal output fro both channels to full cut-off on either channe

Performance figures verified in th test laboratories of one of Australia' leading valve manufacturers.

SIZE: Front panel 13½in long; 4¾in wide Depth not more than 7in behind panel.

COLOUR: Front panel is light Beige with whit calibrations, white knobs with lacquered, turne brass inserts. Because of its attractive, entirel neutral shade the panel will in no way clas with surroundings.

MOUNTING: The unit is arranged to moun easily on any one of four cabinet-panel thick nesses, i.e. 3/8in, ½in, 5/8in and ¾in, No sawing necessary only holes need be drilled. Amplifier, however, must not be mounted "face-up.

Retail Price £59/17/6

The Ultra-Linear Stereo Six-88 Amplifier is th newest addition to the splendid Aegis range o Stereo and High-Fidelity Units such as the 5 Ultra-Linear Basic Amplifier; Standard Contr Unit; Stereo Coupling Unit; Pre-Amplifiers Mar 1 and Mark 2; Fidelity Radio Tuners Mark 1 an Mark 2.

See them on display now at your local Aegi dealer or, if they're not available locally, writ direct for details to Aegis Mfg. Co. Pty. Ltd 208 Little Lonsdale St., Melbourne, C.1., Victoria. FB3731. (ADVERTISEMENT.)

A 10-WATT B-CLASS MODULATOR

(Continued from Page 37)

s, but may be desirable where your ticular layout results in only marginal bility.

Higher frequencies are attenuated by 20 pF capacitor at the plate of the 86. Actually, there is a low-pass filter er on in the system, but it is not de- ble for speech components not actu- being heard in the output to affect AGC system, and hence the average el.

GC DELAY

Two refinements contribute to the effi- ncy of the AGC system. The first is introduce a delay voltage into the C rectifier so that the control volt- does not come into operation until ertain speech voltage level is exceeded. l gain is therefore available for dis- t speaking conditions. This is not de- ned to encourage operators to work ong way from the microphone, where side noises will become obtrusive, but ner to improve the overall efficiency the system at the cost of one re- or.

An AGC system which tends to fol- the peaks rather than the average el of speech is brought about by in- ding a rectifier in series with the AGC d to the EF86 grid. The polarity is h that the gain is reduced quickly en speech commences, but full gain not restored until the charge on the r capacitors has leaked away through 22 megohm resistor.

This arrangement results in a more stant degree of clipping than would AGC system following the average el of speech.

By the way, ordinary germanium des are not suitable for any one of four positions in this circuit because ir reverse resistance is too low. The con variety are fairly readily avail- e now, although they are expensive. space is not a problem the 6H6's gested in the December, 1957, issue be purchased for a few shillings.

From the plate of the 12AX7, the ainder of the output goes to the clip- circuit consisting of a pair of silicon les and a resistive network. The vol- e at which clipping occurs is deter- ned by the voltage drop across resis- which are part of a high tension tage divider circuit. The impedance of circuit is made sufficiently low for audio currents to have negligible ef- on the average voltage level.

RIES RESISTOR

series resistor is placed between the io amplifier and the clipper in order raise the impedance of the circuit ensure clean clipping even if the les do happen to have some series stance.

peech waveforms tend to be quite ky. Little average energy is contained the peaks but if they are allowed to dulate the transmitter, they reduce the rage level which can be maintained hout overmodulation.

ractical tests have shown that it is sible to increase the average voltage plitude by a factor of 2 to 1 for the e peak amplitude by means of clip- with little obvious effect on the quality. In the case of a 20 watt transmitter, this is equivalent to using 80 watts unclipped.

In practice, it works out very much as it does on paper and a transmitter with an efficient clipper sounds as though it has a lot of audio with comparatively little carrier. This is a much less expensive way of obtaining good communication than large transmitting valves and power transformers.

Constants of the present circuit are so arranged that clipping level is about 6db with a crystal microphone under normal speaking conditions. It will increase under very close speaking conditions and decrease if a low output microphone is used at greater-than-normal speaking distance.

A gain control in the normal sense is not required since the circuit adjusts itself to the input supplied. Instead, a modulation percentage control is connected at the output of the device. This is adjusted with the transmitter operating so that 100 pc modulation is not exceeded under any conditions. It will then be found that the average percentage of modulation is quite high.

LOW PASS FILTER

After clipping, the speech waveform contains many high order harmonics which will cause the transmission to spread in the same way as overmodulation. These must be removed by a low-pass filter before being passed on to the modulator proper.

A simple filter making use of two inductors cuts off sharply all frequencies above 3.5 Kc and thus removes most of the distortion components. The total bandwidth occupied by the transmission is then only 7 Kc.

We have noticed by the way, that some overseas publications recommend that the maximum frequency be limited to 3 Kc or even 2.5 Kc. Our own observations are that the additional bandwidth increases the intelligibility enormously but if you would like to try the further restriction on bandwidth you could order suitable filter inductors.

The inductors we recommend for the 3.5 Kc cut-off filter are available commercially under the Bramco trade name. One has an inductance of 0.14H and the other 0.4H.

It is most convenient to make the filter operate at low impedance and use a cathode follower to feed the network. A further advantage of transforming the circuit to a low impedance at this point is that the feed to the modulator proper can be run through the same cable as the modulated high tension lead with negligible interaction.

Maximum output from the filter is about 2 volts rms so that there is a reserve of gain for driving the modulator described here.

If you already have a satisfactory modulator and would like to increase the effectiveness of your transmission there is no reason why the preamplifier-clipper-filter section could not be used in place of your present microphone preamplifier.

This section is designed to operate with a supply of 250 to 300 volts and requires from 8 to 10 mA.

The purpose of the auxiliary socket on the modulator chassis is to permit the equipment to be operated from a DC power source. Normally a genemotor or a DC to DC converter would be used to provide the high tension and would simply be fed in parallel with the existing high tension line. Capacitors already in the power supply will assist in the filtering.

However, the filament windings of the power transformer have a low DC resistance and it is necessary to separate them from the valve heaters when a DC heater supply is used. External heater supply may be fed into the auxiliary socket between pins 3 and 4. If pins 4 and 5 are bridged AC will be supplied in the normal way.

By suitably wiring plugs to connect to the auxiliary socket, power can be taken off to operate a frequency meter, crystal calibrator or any other device you may require at the operating point.

It is hoped to describe the transmitter later and finally the receiver which makes up a complete portable amateur station.

audiocraft PTY. LTD.
SPECIALISTS IN ALL TYPES OF
CABINETS
FOR HI-FI EQUIPMENT
We manufacture a wide range of speaker enclosures
and complete home HI-FI systems.
SHOWROOMS AND FACTORY: 82 GLENFERRIE RD., KEW E. 4 VIC.
PHONE WA5559 At tram terminus OPEN SATURDAYS

ROYCE DISC RECORDING EQUIPMENT
HI-FI CUTTING HEADS, HOT STYLI, AMPLIFIERS
Labels, Stroboscopes, Turntables, Blanks and All Accessories for the Recordist. Write for Catalogue of Prices.
VIC. BOX 5041Y, G.P.O., MELBOURNE. FB2592
ROYCE RECORDING SUPPLIES, 291 EXHIBITION ST., MELB.
S. A. SCOTT ASLES, 99 CURRIE ST., ADELAIDE. LA1201. ML4919.

METROPOLITAN RADIO SUPPLIES
640 KING STREET
NEWTOWN, SYDNEY

IMPORTANT ANNOUNCEMENT

This business has been acquired by NUCLEAR ENGINEERING PTY. LTD. and is now being carried on under entirely new management.

The stocks of Surplus radio equipment will be carried as hitherto, but in addition the business will carry a comprehensive range of new and imported lines including electrical measuring instruments, optical instruments, camping gear, compasses and a host of lines to interest sportsmen, draughtsmen, car owners, farmers, handymen and hobbyists.

We cordially invite you to call and inspect our range and feel certain that you will find many lines of interest.

All future mail orders will be given special attention.

PLEASE NOTE:

640 KING STREET, NEWTOWN, is now the only address of METROPOLITAN RADIO SUPPLIES

TYPICAL, COMPLETE PLAYMASTER

(Continued from Page 67)

voltage is normally above the figures quoted, it can be reduced by increasing slightly the value of the resistor in series with the transformer secondary.

The same method can be adopted if the voltage proves to be on the high side with no tuner in use, or with a tuner carrying its own power supply.

Again, if it is desired to put only one channel into service, the series resistor can be about 40 ohms for just the amplifier and control unit, or about 35 ohms, if a tuner is involved. The resistor in each case would need to be rated at about 10 watts.

CHOKE TUNER

The filter choke, incidentally is simply shown in the circuit as 1 henry 50 ohms. These figures are approximate only. In actual fact, the choke in the original amplifier was the same type as used for our television receiver, having a nominal inductance of 1 henry at 285 milliamps and a DC resistance, depending on the brand, of between 30 and 50 ohms.

Incidentally, the voltage to the tuner will be too high with everything connected together as shown. We suggest that an additional 5000-ohm 5-watt resistor be wired in series with the HT supply line within the tuner.

The wiring of the new amplifier follows very closely that worked out in the January issue for the earlier version.

Most of the small components are mounted on a terminal panel with 16 lugs per side. The components can occupy the same positions as shown in the January issue (page 35), though we did make one small change, just for convenience. This involved using one lug for each plate connection to the 6CG7 load resistor and coupling capacitor, leaving a lug vacant to provide the junction point for the 4,700 ohm and 470 pF. step components.

LEAD WIRES

The power and output transformers pictured are a new line by "National," and, as an economy measure, are being marketed with leads rather than terminal panels. This makes it necessary to use tagstrips beneath the chassis, which constitute a further point of difference in the wiring detail.

We used a 7-tag strip near the rear of the chassis to terminate the mains and heater wiring, with a 5-tag strip nearer the centre to carry the HT secondary leads and the series resistor.

A 5-tag strip under each bolt holding the speaker output strip provides a termination for the secondary leads. These are then wired to the output terminals and feedback components as indicated. Note that a switch has been included, allowing the phase of one speaker to be reversed easily, rather than by the slower process of swapping over leads.

It does not matter in which of the secondary circuits the switch is installed, since it is sufficient to reverse the phase of either speaker to secure the desired acoustic effect.

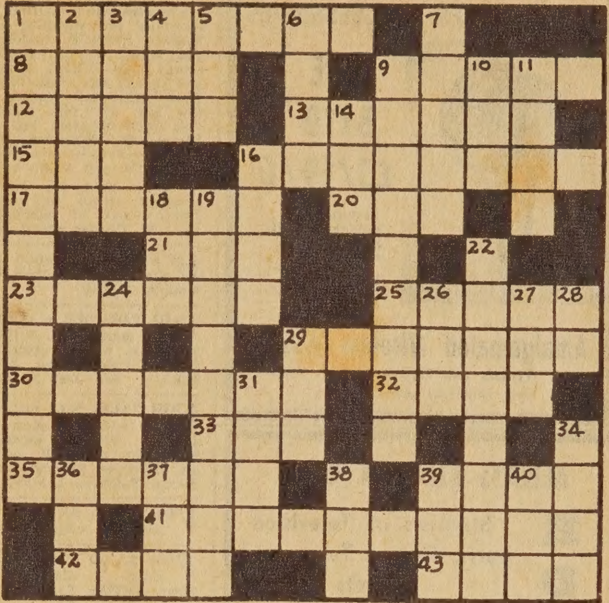
As is common practice, these days, wo secondary windings are provided which, correctly phased, provide 3.75 ohms in the parallel connection and 15 ohms in the series connection.

Information is normally included with the transformers as to the connections necessary to obtain the desired impedance. It will still be necessary, however, to establish the correct polarity of the total secondary to produce negative feedback.

The circuit shows the constants which will be required for the usual 15-ohm connection. Note that the phasing capacitors are shown as 270pF, being the value which appeared optimum with these particular output transformers. If other types are used, the value may be lower (see original circuit) or as specified by the particular manufacturer.

On test, the frequency response and squared waveforms closely approximated those shown in the January issue.

THE R., TV & H. CROSSWORD No. 68



ACROSS

1. Measure of the performance of an amplifier.
8. To entertain pleasantly.
9. Wide.
12. Raves.
13. An alkaline earth metal.
15. Period of time.
16. Switching arrangement.
17. Sketch of a plan to be applied.
20. Town in New Guinea.
21. Lion (Latin).
23. A subtractive primary colour.
25. Unit of elastance.
29. A type of battery.
30. A unit of brightness.
32. City in Texas, U.S.A.
33. River in Scotland.
35. Cold conditions.
39. The measured progression of events.
41. Relative to past events.
42. Man's name.
43. The outer covering of fruit.

DOWN

1. A law of electromagnetic induction.
2. A spurious response in a superhet.
3. Hills of Sand.
4. Is (Latin).
5. Man's name.
6. Thermionic valve (American).
7. Cost.
9. Insulation failure.
10. Dismissed (cricket).
11. Violent and irrational assault.
14. The whole.
16. "Noise" on a TV screen.
18. Sick.
19. Pertaining to the measurement of angles, surfaces, etc.
22. Customary actions.
24. Unit of luminous flux.
26. Associate of the Royal Academy (init.).
27. In time past.
28. Federal Executive (init.).
29. Inflamation of the eyelid.
31. Various forms of radiation.
34. Used to sound an alarm.
36. Irish Republican Army (init.).
37. In grammar, the definite article.
38. Positively charged molecular particle.
39. To fall to one side.
40. Girl's name.

Solution and further crossword next month

Last month's solution

L	I	N	E	D	R	O	P			M		A
	M		L	I	A	R			B	I	A	S
S	P	R	E	A	D	I	N	G		L		H
	U		C	L	I	E	N	T	E	L	E	
G	R	I	T		O	N	E		W	E	B	S
	I		R	E	S	T		H	E	R	O	
	T	R	O	O	P		P	A	R	E	N	T
	I		S	N	E	E	R	S		F		E
B	E	A	T		C		O			F	I	T
A	S	I	A		T		B	A	S	E		R
L		S	T	I	R	R	E	D		C	O	O
S		L	I	E	U			E	A	T		D
A	L	E	C		M	E	A	N				E

AWA RONETTE

MICROPHONES & ACCESSORIES

TYPE
B110
£3/19/6

Technical Pamphlets will be mailed on request.

Other types also available from

Amalgamated Wireless (Aust.)
Cnr. William and Newcastle Sts., Perth.
and leading wholesalers

ALWAYS RELY ON R.D.S.

R D S Stockists of Television parts, Picture Tubes and Turrets

We can supply all Radio and Electrical Components and are agents for the famous Hotpoint Radio Sets, Distributors of Test Equipment, Valve and Circuit Tester, Multimeters, etc A complete Mail Order Service for the Countryman. Call, write or phone to

The independent Wholesaler
RADIO DESPATCH SERVICE
Radio and Electrical Distributors,
GROUND FLOOR, WEMBLEY HOUSE,
841 GEORGE STREET, SYDNEY.
Phone MA1876. Open Saturday Mornings.

TAPE TO DISC

7" 45 E.P. Under 10 mins. £1/12/6
10" 33 L.P. Under 34 mins. £3/2/6
12" 33 L.P. Under 45 mins. £3/12/6

The above times are totals of both sides.

★ SEND YOUR TAPE NOW!

SONIC LABORATORIES

Specialists in Studio and Outside Recording
FU3227 Box 2325 G P O Sydney FM3545

or call J STANLEY JOHNSTON PTY LTD
437 George Street, Sydney

★ Enclose instructions, cash, and 2/6 postage.

We supply **Radio Accessories**, including Valves, Resistors, Condensers, Transformers, Players and Changers etc., also Sets. **Television Accessories**, including Picture Tubes, Valves. Antennas, Tuners, etc.

Black and Decker and Sher Drills, Sanders and Kits.

Electrical Appliances, including Irons, Steam Irons, Toasters, Percolators, Polishers, Shavers, etc.

Transistor Sets, Miniature 6, Mantel 6 and 7 Car Sets, Car Aerials.

Open week days, 9 to 5; Saturdays, 9 to 12.

DAVIS RADIO CO.
Wholesale Distributors,
6a Annandale Street,
Annandale. Tel. LM4556.

WANTED TO BUY, SELL OR EXCHANG

A.A.A. TELEVISION ANTENNAS. SAVE MONEY—BUY DIRECT. Complete do-it-yourself kits including high performance pre-assembled antennas. FRINGE AND SUPER FRINGE models from £5/4/. Towers and masts to 170ft from £5/5/. Catalogues by return mail. FREE delivery to YOUR door in any capital city. Installed in Melb. from £6/10/. Ring, write, call anytime. Also, Special—only a few left: 45 r.p.m. Record Players, run off 6-volt torch batteries, just £3/19/6. **Skybeam, 76 Nimmo St., Essendon, Vic. FF9348, all hours.**

ALL TV and Radio rprs., including I.F. alignment, mod. lab. equip. ensures 1st-class job. Contract wiring, etc., undertaken. Pick-up and delivery srvs. if required. **TV Alignment Service, 92 Cooper Street, Surry Hills. MA6948.**

BUY: Communication receiver — what offers? State price to **Fred Eade, 276 Park Avenue, Kotara, N.S.W.**

DID YOU SEE our full-page adv. in the October issue? See P.120. A copy, plus various brochures, will be posted free on request. **Electronics Publications, 11 Cadow St., Pymble, N.S.W.** We deal by mail only.

FOR SALE: Back nos. Radio and Hobbies, 1939 to 1954. Copies, 2/, 1955 to 1957, 3/, 1958 to 1959, 4/, including postage. Also will buy spare copies R. and H., Practical Wireless and Hobbies Illustrated. **A. J. Cox, 13 Glover Street, Belmont, N.S.W.**

FOR SALE: Elcon 15 W. amplif. 12in and 6in Alcomax, crossover. **Ring UB7205.**

FOR SALE: General Electric GC5 stereo cartridge .5 diamond stylus, new, £12/10/. **Myer, JX2956, Sydney.**

FOR SALE OR EXCH.: 3in CRO separate power supply, £10. **LW6490.**

HOW THE SCHOBER ELECTRONIC ORGAN WORKS. New booklet, priced at only 5/. Available capital city booksellers or from **Electronic Publications, 11 Cadow St., Pymble, N.S.W. Mail inquiries only.**

MODEL ENGINEER, Steel Hexagon Head Screws, 6 and 8 BA. 2/ doz. **BOLTON, 72 King Street, Sydney. Catalogue 5/6.**

MULLARD New Audio Amplifier Manual — 12/6 plus 1/2 postage. Obtainable from **Albert Wright, 793 New Canterbury Road, Hurlstone Park, N.S.W. LL2696.**

ORGAN Keyboards, with springs, £26 plus freight. (Contacts extra). Also pedals £35 plus freight . . . Write **Electronic Organ Co., 11 Cadow St., Pymble, N.S.W. Mail inquiries, only.**

REPAIRS to Radio, TV, Xmtrs; Construction, Wiring and Testing. TV alignment. **Eccleston Electronics, 146a Cotham Road, Kew, Vic. WY3777.**

SELL: Hallicrafters S.29 battery AC/DC portable comm. receiver, 500kc-32mc., 4 bands with B/spread tuning 9 tubes mvc/avc, excellent order. Complete with spkr., etc., £30. **SELL:** H/duty pwr. trans. 240v AC 750v aside CT 350 ma. 250v 250 ma. 4v 3 amp. 5, £5/10/. **SELL:** quality 5/10w Aud. amp., £10. **SELL:** 6.9 mc Command TX converted 12v fils. Bfo u/c with spkr. in cabinet. Tube spares. £7/10/. **A SHAW, c/- P.O., South Brisbane.**

MULLARD STEREO AMPLIFIERS, 2-2, 5-7, also 3-3, 5-10 and Tuners. Approved by and to their specifications. Stereo Pickups and Players. **ALBERT WRIGHT, Radio and Cabinet Manufacturers. Est. 24 years. 793 New Canterbury Road, Hurlstone Park, N.S.W. LL2696.**

STEREO PLAYERS: Used only for testing purposes, guaranteed as new. Dual £16, Collaro £21. Philips £10/10/. Garrard £30. **ALBERT WRIGHT, 793 New Canterbury Road, Hurlstone Park, N.S.W. LL2696.**

SELL: New 17 watt Playmaster, 1958 version, Bramco O.T. bench tested; also quality Radiogram chassis. **C. N. Bennie, 53 Outlook Drive, N.22, Melbourne. JL4112.**

SELL: Grundig T.K. 35 Tape Recorder, in new condition. Microphone and extra leads. £130. **99-7303, Sydney (evenings).**

SELL: A.W.A. 15w AC/Bat. Amp., £22; SCR 522 chas., 30/; 2 T'phones £4 ea.; 1500w 24v Gen., new, £10; Micr. stnd., £3. **1 Darley Road, Randwick.**

SELL: A.R. and T.C. Radio Serviceman's Course complete, M'meter, osc, and sig. tracer panel incomplete, all parts supplied. Lot or separately. Reasonable offer acepted. **P. Hogan, Churchill St., Childers, Qld.**

TRANSPORTA CABINETS, also Transistor all parts, also Philips 6v battery NG1012. TV cabinets complete or kit also masks and safety glass. **ALBERT WRI 793 New Canterbury Rd., Hurlstone Park, N LL2696.**

SELL: Modern Communications receiver m/cs turret tuning, £40 O.N.O. **A. 15 Bridge Street, Pooraka, S.A.**

SELL: All back issues R.T.V. and H. in at all times. 1939-56 copies [illegible] onwards 2/6 ea. Postage included. [illegible] or call **T. Weir, 56 O'Connor St., Sydney, N.S.W. UA2569.** Will [illegible] locally.

SELL: Ferguson Tran. OP/301/15, [illegible] **MW0522, ext. 301, Sydney.**

SPEAKER ENCLOSURES, complete form, from £6/18/. Rola, Goodman, lard, Sherwood, Axiette, Wharfdale, Philips, Magnavox, etc. Also matching A cabinets and full range of Speakers. Sarlo Tygan plastic cloth, etc. **ALBERT WR 793 New Canterbury Road, Hurlstone N.S.W. LL2696.**

SELL: Senior portable less batteries, £ Amplifier 15W. P.P.2A3's with Rola vent, £14. C.R.O. Trannie P.F. 545, £3 valves and parts, etc. Write for list. **L. 105 McKellar St., Benalla, Vic.**

WANTED DEAD OR ALIVE! 100 RECORDERS. Demand for used corders has never been better. We mus more stock, so bring in your tape-record get cash in a flash! No fuss—no delay— top spot cash for your used tape recor **MAXWELL'S Tape Recorder Centre LONSDALE ST., MELB. MY1351. " corner of Lonsdale and Elizabeth Streets.**

WANTED: AR7-rcvr. Complete. **Cus Levien Ave, Tamworth.**

WANTED: Reslo Reflex Horns or public address speakers. **P. Newton, well St., Kingsgrove, N.S.W. Phone LY7**

SPEAKERS, very slightly used, guaran new, Magnavox 12WR, £5/15/; 8W MSP 12in Radial Beam, £15; Philips £10; 9762M, £15/10/. Also sample A and Stereo Players at reduced prices. **A WRIGHT, 793 New Canterbury Road, H Park, N.S.W. LL2696.**

Highest TV mast

THE aerial system that top 1,000ft mast—tallest in the ish Commonwealth—erected at M sham, Suffolk, to carry ITV's Anglia program from the stud Anglia Television at Norwich, is type specially designed to provi unsymmetrical radiation pattern to meet the requirements of the

Known as the Mesny Type, the system was designed by E.M.I. El ics Ltd. It has several advantag other conventional systems, in the fact that because fewer feed are necessary than normal, the problem is simplified and the complexity reduced.

The mast is triangular in secti sides 6ft 6in wide at the aerial The aerial system consists of each 50ft long. The unsymmetric ation pattern required from the could not have been met ad with an aerial of conventional

Strong signals were required directions of Norwich, Peterb Cambridge and Colchester, but t ation had to be reduced drastic ward London, the South Co Amiens areas, to meet inte planning requirements.

[illegible] adiation system provide tionally high aerial gain, enablin paratively low input of 8kw transmitters to give an effective power of 200kw in the desired d

---

Printed and published by Sungravure registered office: 21-29 Morley Avenue, N.S.W.